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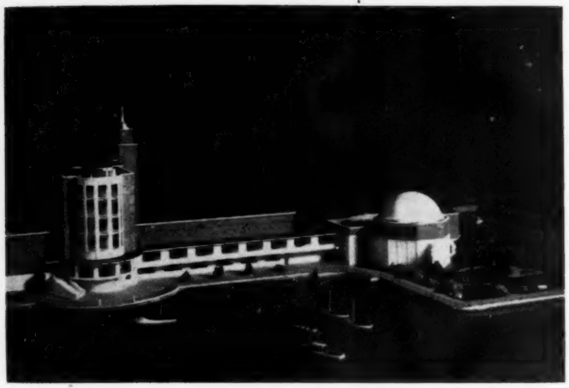
THE SCIENCE TEACHER

JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION



THIS MONTH'S COVER . . . shows a model of the new Museum of Science, Boston. Now operating in the east wing and planetarium-auditorium (right of tower), the Museum is the first of its kind to combine natural history, science, industry, public health and a planetarium. This is a reminder that the December meeting of NSTA and the other AAAS Science Teaching Societies will be held in Boston, December 27-30 and an attractive program has been planned.

Readers' Column

My son Philip, who is away at camp, has requested that I write to you concerning his winning a first place award. May I take this opportunity of expressing my personal sentiment. In these times when so much is heard about "delinquent youth," it is refreshing to know that there are organizations such as yours who by your work, stimulate youth into channels which will not only direct their inquiring minds and love for adventure into channels that are constructive, but will fit young men and women for careers that will be of help to themselves and to others.

PAUL A. LICHTMAN, M. D.
Washington, D. C.

I am happy to learn that my science project has won a second place award. I enjoyed working on my science project. My science teacher of the past two years gave me constant encouragement. I have been very fortunate to have had an excellent science teacher at Haven School, Mr. Steve Hall. Thank you for the Savings Bond.

EUGENE MOHR
Evanston, Illinois

Thank you for your letter advising that (our son) has been named a recipient of a first place award in the 1953 program of Science Achievement Awards. Words cannot express how appreciative Paul was in receiving this award and how much encouragement this will mean to him in the future in his study in the field of science. I want to congratulate the sponsors of this award and the foundation that has made this work possible.

ALEXANDER BREST
Jacksonville, Florida

In response to your invitation to join in the discussion of the oar as a lever (September *TST*, p. 152): We point out that any point of a lever (including an arbitrary point where no force is applied) can be considered a fulcrum, and that moments of all forces will show equilibrium. This clearly indicates that the concept of first or second-class levers has no meaning and that the controversy raised by Mr. Schneider is nonsense.

In addition, we question Schneider's use of the term "mechanical disadvantage." We can understand a mechanical advantage of less than one, determined after an arbitrary fulcrum has been established.

Must we clutter up students' minds (and our own) with unnecessary terms such as "class of a lever" and "disadvantage"? Why not in the statement of a problem indicate that the fulcrum is to be considered at a certain point for uniformity of discussion, or, preferably, leave the student free to do constructive thinking by selecting his own fulcrum?

DAVID T. THIELKING
Town of Tonawanda, New York

I am more than delighted with my copies of the *Science Teaching Today* books by Guy V. Bruce. My supervisor agreed that this is the most practical science series we have seen to date. We are trying to get all the schools in the system to purchase sets of them.

HERMAN C. HENDERSON
Houston, Texas

This is to acknowledge and thank you for the $50 award given to me in the 1953 program of Recognition Awards for Science Teachers. I already have my eye on the 1954 program and will get my entry in on time, February 15. The stakes are certainly high and I imagine the competition will be keen.

MRS. RUTH ESSIG
Inglewood, California

Just a short line to tell you that *The Science Teacher* and your *NSTA News Bulletin* are publications which I read completely. Also, the Packet Service alone, in my opinion, is worth the price of NSTA membership.

W. R. CHANNELL
Kansas City, Kansas

THE SCIENCE TEACHER

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REMINDER to

TST READERS AND SUBSCRIBERS:

This is the last issue of Volume XX and of the calendar year. Publication will be resumed in February 1954.

Editor's Column

Forgive me, please, for using one of my own children as a case study. But if recent calls upon my knowledge and time to help N. get her lessons are a good example, then it would seem that we as teachers should see to it that "homework assignments make sense."

For instance. A few weeks ago the chore was to "make drawings to show the Mercator, conic, and polar projections." Why? "That's what we're studying." Why should anyone want to make such maps? "I don't know." Have you seen any models or illustrations to show the *ideas* of how these maps are made? "No." (My own thought: "Why should *7th-graders* be asked to make such drawings, anyway? This is a job for professionals.")

Enough of these thoughts, however; we've got to get a good mark. So off we go to a study of some pamphlet materials that were prepared by one of the aircraft companies during World War II when there was lots of emphasis on navigation. First, though, we talked over *why* people have made attempts to portray the spherical earth's surface on flat maps. Then we found a nice illustration to show what's behind the Mercator projection. But we ended up with more than a drawing.

We used a transparent plastic ball to represent the earth. We put into this a paper equatorial plane and a broomstraw axis. We drew parallels of latitude every 15° north and south of its equator. Then we wrapped a large sheet of transparent plastic into a cylinder around the plastic "earth," and, with the eye out in space and pointed toward the center of the earth, rather than the reverse, we made projections onto the rolled-up, flat surface. After we had made a goodly number of point locations on the cylinder of plastic, we unrolled it, connected the points, and looked at our distorted but useful flat map which represented the earth's surface.

I can't prove it, but I *think* that by now this homework assignment made more sense. More recently, though, we've had more memorizing and writing of definitions to do: *relative humidity, dewpoint, precipitation,* etc. With no demonstrations or realistic experience-recall to start with, these concepts (some of the most difficult in science) have only the most meager meaning. And so we've started to construct homemade wet-and-dry-bulb thermometers, dewpoint apparatus, wind box, etc.

I wouldn't want it thought, however, that I'm joining the ranks of carping critics of schools and teachers. Most of us, I believe, are eager to find new ways of making our teaching take firmer hold on young minds. In the situation I have been illustrating, my tactics have been directed, first, toward helping my own child develop deeper understandings and insights, and second, toward a hoped-for "feedback" effect into the classroom and into future lessons.

Is this a good way for a school patron to behave?

Robert H. Carleton

P.S. Believe me, I did *not* read pages 477-78 of the November *NEA Journal* before writing this.

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THE SCIENCE TEACHER

Vol. XX, No. 6 November 1953

Articles published in THE SCIENCE TEACHER are the expressions of the writers. They are not a statement of policy of the Association or the Magazine Advisory Board.

The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

CONSPIRING TO INSPIRE

THROUGH THE TEACHING OF SCIENCE

By WOOLFORD B. BAKER

THE topic suggested for discussion tonight caused some misgiving on my part since the mere suggestion of participation in a conspiracy of any type at the present time usually calls forth an investigating committee and brings the conspirators under condemnation or suspicion.

In order to be doubly sure I was on safe ground, I consulted my dictionary to check the term conspiracy. I found it to be derived from *"con"*—together, and *"spirare"*—to breathe. Certainly there could be no possible objection to our *"breathing together."* I was disturbed when I found that usage gives a more sinister definition: *"A secret combination for an evil purpose."* But I was reassured to find also *"A concurrence of persons to surprise."* I do not think our deliberations are supposed to be held behind closed doors—to be carried on in secret—that our conclusions should be off the record or that we are gathered together for an evil purpose.

We are going to do nothing tonight that needs to be kept secret, even though secrecy can sometimes be used to attain certain ends. Vice President Barkley tells of a mule trade between two of his friends in Kentucky. A fine looking mule was bought by Jones from Smith. When Jones got his purchase home and turned him in the lot he discovered the animal was blind. The next day he went to Smith and said: "Why didn't you tell me the mule was blind?" Smith replied: "Well you didn't ask me and besides, the man I bought him from didn't tell me, so I supposed it was a secret."

But we are asked *"to breathe together"*—to *"inspire."* Now just what is meant by inspiration? The dictionary says to inspire is *"to animate or kindle," "to stimulate—to inbreathe or impart an idea, emotion, etc., hence lofty thoughts."* As I understand it then, we are supposed to *"breathe together"* in order to *"animate or stimulate our students, to impart to them ideas, emotions, and lofty thoughts"* through the teaching of science. Certainly there can be no objection to such an activity.

But what is meant by science, the vehicle through which we will seek to inspire? Many definitions have been proposed. It seems to me science is a pattern of human behavior by which man discovers, accumulates, systematizes and tests by controlled experimentation the knowledge of himself and his environment gained through the experience of the sense organs, the reason and intuition. Science is thus dynamic and accumulative. One discovery leads to another; one theory or hypothesis furnishes the starting point for further investigation.

Dr. Conant, formerly President of Harvard gives quite a descriptive definition:

> "Science is a series of interconnected conceptual schemes which arose originally from experimentation or careful observation and were fruitful of new experiments or observations. Science advances not by the accumulation of new facts but by the continuous development of new and fruitful concepts."

Thus science is a method of thinking, a pattern of behavior by which truth is discovered and tested. The power to think and to reason are the most significant characteristics of man. If we can stimulate our students to think objectively, logically, without prejudice or bias, we will have contributed much to their preparation to meet the problems of life.

If we are to get our proper bearings regarding our subject we must distinguish between pure science, a world of ideas and applied science or technology, which is a world of things. The two are confused in the minds of the general public. Most people accept without question the countless conveniences and gadgets which have come about through the application of the ideas and principles of pure science. They are inclined to look with suspicion, however, at the worker in pure science and are prone to blame him for much of the confusion and bewilderment of our present age.

Science provides a sort of stockpile of ideas and understandings from which technology draws for advance in application and invention. Technology becomes sterile and entirely empirical unless pure science forges ahead with replenishment of the stockpile. In many areas the stockpile is alarmingly low at the present.

Science is a matter of individual ingenuity and imagination. Technology advances largely through organized group effort, directed by a research committee or a government bureau. Imagine if you can a Darwin, a Pasteur or a Mendel becoming a part of operation X, Y, or Z.

The values of pure science are measured in terms of long range understandings while those of technology are significant in terms of immediate utility. Science seeks to understand, technology to control and exploit. Science is essentially creative as is art, music, literature or drama, while technology is carried on according to empirical formulae.

The discoveries of science are usually unpredictable and lead the investigator farther into the unknown. Technology seeks to meet specific needs in areas already familiar.

Science knows no national boundaries but has been the product of many minds in many nations. We do not concern ourselves with the nationality of Copernicus, Hippocrates, Helmholtz or Euclid but rather with their contributions which are the property of all men. The products of technology are restricted by military secrecy, industrial competition, government patents or patriotic nationalism.

In much science teaching more emphasis is given to the technical applications of principles rather than to the fundamental understanding of the natural phenomena involved. There is certainly less inspiration to be had in giving the empirical formula for a dose of medicine than in finding the basic cause of the disease for which the dose is prescribed. The great impact of science on human progress has not been due as much to the many gadgets of the engineering laboratory as to the ideas and conceptual schemes which have changed men's thinking.

But why should teachers be asked to inspire students?

Man rises above his mere physical nature and begins to live as a man, unique among other creatures in proportion to the extent to which he is inspired—animated—kindled. He seeks food, shelter, protection and companionship because of physical necessity but he creates in the fields of art, literature, poetry, music and science when he is inspired. Since he is not "a finished and finite clod untroubled by a spark" he may get inspiration from within. In most cases, however, through association with others of kindred spirit, experiences in living as a sentient, rational creature, he becomes inspired from without.

What are some of the characteristics of youth to which science appeals?

1. *In the first place, youth is inquisitive.* Young animals seem to have a natural, inborn curiosity about their environment. Kittens, colts or calves are curious about everything around them. They go from place to place, sniffing here and there until the pasture or the barn lot is familiar to them. A normal young child likewise pokes his fingers here and there, kicks at pebbles, tin cans, boxes and bags, turns the switch, pulls the lamp cord, moves the steering wheel, tastes the leaves, smells the flowers, punches at bugs with an insatiable curiosity. The questions even a five-year-old can ask are sufficient to confound the wisest parent or teacher.

It has been said that one of the results of our present educational system is to dull the curiosity of the child. Certainly an active science program does not do this. One of the chief characteristics of the true scientist is his inquisitiveness.

2. *Youth possesses imagination.* We adults sometimes think this is carried to extremes, but here again is one of the principal attributes of the scientist. The great hypotheses and theories which form the stepping stones for scientific advance have been formulated by persons with a vivid imagination.

3. *Youth is skeptical.* One has only to see a group of teenagers at play or at work and hear their "O, Yeahs"! and "Says Whos" to realize the skeptical manner in which they face their experiences. The scientist is skeptical about hastily drawn conclusions, traditional authority, or mass thinking until he can prove their validity by experiment.

4. *Youth likes to do things, to manipulate gadgets.* The broken down Model T Ford was the

In view of recent pronouncements by a number of highly vocal college professors in which they have severely criticized the American high school, its teachers, and its products—and at the same time, in our opinion, revealed their own considerable lack of knowledge and understanding of what the high school's job really is and how well it has been done—it is encouraging indeed to have an article like this one which presents the optimistic view and in such a refreshing manner.

Dr. Baker has been Professor of Biology at Emory University, Atlanta, Georgia, since 1926. Born in Las Vegas, New Mexico, he took his AB degree at Henderson-Brown College, the MA at Emory University, and the PhD (in protozoology) at Columbia University. However, Dr. Baker speaks from no ivory tower. He has maintained a deep and sincere interest in high school science teaching through the years. He works closely with the schools and teachers in his locality and state and has visited schools widely throughout the United States. Hence he knows high school science teachers, their aspirations, their problems, their resources, and their roadblocks.

It was delightful to have Dr. and Mrs. Baker in attendance at the NSTA Regional Conference with NEA in Miami Beach, Florida, last summer and to hear him read this paper at our dinner session on June 28.

starting point in the development of many of our best engineers. A chemical set or a set of batteries and bells stimulated many a boy or girl to go into chemistry or physics. A microscope and a few stains have aroused an interest in biology. Science is an excellent field for tying hand and head together. The many novel and ingenious gadgets the youngsters put together in carrying out a science talent search project are most stimulating.

5. *Youth likes to be shown.* This is the essence of the experimental method. The tentative explanations of the scientist regarding natural phenomena become the policies for his experiments. If one experiment fails he devises another. An alert young boy or girl usually shows intense interest in the setting up of a well planned experiment to test some scientific principle or theory. I have watched with great satisfaction the faces of pupils in a science laboratory directed by an enthusiastic and well trained teacher. I have listened to the suggestions made as to the possible technics and outcomes, then have seen the gleam in sparkling eyes when satisfactory results were observed and basic facts proven.

6. *Young people on the whole are hero worshippers.* An understanding and sympathetic parent or an experienced and enthusiastic teacher is a hero to many a child. In the field of science are to be found some of the greatest heroes in human history. Frequently they have been rejected by their contemporaries because they were different and their ideas tended to go against tradition or current practices and beliefs. Roger Bacon, who first stated clearly the fundamental experimental method of discovering truth, spent more than 14 years in prison. Galileo suffered martyrdom and ridicule because he dared state beliefs based on experimental proof but which were contrary to the accepted tenets of the populace. Lavoisier, the father of modern chemistry, suffered death on the guillotine because he was suspected by the tribunal for his advanced ideas. As he asked for a few hours delay in order to complete some experiments, the president of the tribunal said, "Enough! The republic has no place for scientists." Even as late as 1875 Pasteur was rejected by the medical practitioners of his time because he dared to suggest that disease was caused by the presence of micro-organisms.

7. *Youth is stimulated by challenges of adventure.* I suppose every teacher has at some time or other heard a lively young boy or girl express the wish that they might have lived in the days of the pioneers who gathered their meager possessions about them and pushed boldly into the frontiers which separated them from the unknown. Most geographical frontiers have been penetrated and there are perhaps no areas on the earth which have not been visited by a pioneer. But there remain some of the most challenging frontiers mankind has ever faced and with which we can appeal to our venturesome youth. These are the frontiers of science. Someone has well said, "The frontiers of today are the frontiers of science." In making this report to the President on the status of science in America, Dr. Vannevar Bush gave the significant title, "Science, The Endless Frontier." It is in this area of science that it seems to me we have our choicest opportunity of inspiring our students.

Since man first became aware of himself as an individual and of the objects and forces in his environment, he has been faced with frontiers which more or less circumscribed his activities. To some, these were barriers, inaccessible and insurmountable; to others they were challenges to be met head on with faith and courage. To some they meant impenetrable walls which shut out dangers lurking in the unknown and gave security and protection for a placid and uneventful existence; to others they

were walls beyond which lay thrills of adventure and conquest. To some they were shields to guarantee the status quo; to others they were curtains which might be lifted to reveal stimulating new experiences, new opportunities and greater freedom.

Thus throughout human history there have been those who were content to let well enough alone, to avoid change, to accept what seemed to be inevitable without question and to let frontiers remain undisturbed. But fortunately for the race there have also been those who, as they looked outward over the seas or across the limitless prairies to the surrounding horizon, dreamed dreams of the good things that might be found if they would but travel on and on and on. How fortunate for all of us that there were those who as they looked at the peaks of the lofty mountains saw not unscalable barricades which shut out their enemies, but rather vantage points from which might be viewed the greener grass of the more fertile valleys which lay beyond. These were the dreamers, the theorists. Their imagination produced hypotheses, "conceptual schemes" which formed the policies for further investigating and testing.

Just as with geographical frontiers, there are many who would leave things as they are, who see protection and safety in the authority of tradition and custom and who dare not penetrate frontiers for fear of finding new hazards and problems which might become troublesome and dangerous. There are others, however, who see in every frontier a challenge and who are willing to exert their best effort to go through the impenetrable barriers and scale the insurmountable walls.

The stirring headlines of our daily press and the alarming broadcasts of our radio news commentators keep us reminded that we are living in a troubled period of history. No man can foresee what the future holds in store for us. Such a situation is not unique in human affairs, however. Thomas Jefferson saw in his day a return of the "law of barbarism" and the "vandalism of the fifth century." Even the psalmist of old wrote, "There be many that say, Who will show us any good?" (Ps. 4, 6.)

In every perilous period in human history there have been produced leaders who met the problems with faith and courage and steered the course of civilization to new levels. We science teachers have the privilege of showing our students that in this age science has provided the knowledge and understanding to give man freedom from many of the dangers and difficulties which have troubled him in the past. Science provides the means by which we might become free from disease, hunger, want, fear, and the back breaking drudgery that kept us from the leisure necessary to live an abundant life. We may well seek to inspire our students to meet the challenges of the future and through their scientific training aid in solving the problems that arise in penetration of new frontiers.

How may we seek to inspire our students? The individual teacher holds the answer. He must have blazed the trail himself or he cannot expect to lead others along its tortuous path. He must have climbed to the mountain top and have seen the grandeur of the view before he can adequately inspire—stimulate—kindle others to make the arduous climb. I would like to suggest three specific methods by which I believe they may be inspired.

(1) By presenting to them the possibility for man of a more comfortable, a richer, fuller and more abundant life through science.

Man has always had a desire to better his conditions. He first had to meet his basic physical needs just as do other organisms. When these had been provided he exerted himself in areas of activity more characteristic and unique for the human organism—creative activities which resulted in his art, music, language and tool making. He soon discovered two methods by which he could get what he needed. Like the savage beasts, he could seize the possessions of his fellows by violence and murder or he and his companions could exert themselves cooperatively and supply their wants through their own creative labor, allowing their neighbors to do likewise. As civilization advanced the two methods of securing the necessities of life remained essentially unchanged. With development of science as a means of gaining understanding of basic principles and of technology as an application of the principles discovered by science, man for the first time had at hand a means by which he could be freed from much of the drudgery necessary to maintain himself. For the first time in history sufficient goods could be produced to meet the needs of all. The standards of living were raised, wealth was created, distance was annihilated, rapid means of communication were established so that man everywhere could know what others were doing and thinking. For the first time in history he had a means of getting good things of life in ways other than through violence.

It is expecting a great deal of man to adapt himself to civilization when we realize he emerged from savagery only some 25,000 years ago. The present era through which we are passing bears this out.

(Please continue on page 309)

Planning Elementary Science Programs

By DONALD G. DECKER

Chairman, Division of the Sciences

Colorado State College of Education, Greeley, Colorado

RECENTLY several elementary teachers met together for the purpose of planning their elementary science programs. Since they represented all grade levels and many types of communities, they were anxious to plan a flexible program that could be adapted to each grade level and each community. The group hoped to develop a program that could be used immediately by each teacher. How does a group plan such a program?

Teacher Activities Essential for the Development of a Flexible, Useful Elementary Science Program

The teachers decided that they would have to engage in six major activities to produce the type of program they could use. The activities and the order in which they were done are listed below:

1. Make a survey of the subject matter content of science that is important for elementary children to study.
2. Select a general theme for the total elementary science program.
3. Select major generalizations related to the theme.
4. Select specific concepts for each grade level that help to explain the generalizations.
5. Develop activities to help children learn the specific concepts.
6. Make questions to direct the thinking of children so that they develop the important concepts related to the generalizations.

How to Survey the Subject Matter Content of Science

Science subject matter content can be organized into three major areas for study by the elementary school teacher. These three areas are:

1. The changes in the life span of plants and animals.
2. The changes that occur on the earth and in the rest of the universe.
3. The changes that occur in matter-energy.

The Selection of a Theme for the Elementary Science Program

The organization of science subject matter content into the three major areas helped the teachers identify an important theme for the elementary science program. The theme they selected can be expressed in one word, change. The statement of the theme in sentence form was:

Everything in the universe is in a constant state of change.

The desirability of this theme was determined by asking the questions:

1. Do children have everyday experiences with this idea?
2. Is the idea an important one to study in science?

The concept of change is not new to children. Children of all grade levels have many experiences in which change is evident. These experiences have already made them familiar with the idea. Children have experienced a change in the seasons each year. They associate definite activities with summer, autumn, winter, and spring. Children have watched the sun rise and set, the stars change places in the heavens, and the planets appear and disappear. Children have themselves changed and grown from year to year. They have observed the changes that take place in plants and animals as they grow and develop. Most children have seen seeds sprout in the spring, grow into plants, bloom, produce seeds, and die. They have seen puppies, kittens, chickens, and brothers and sisters grow and develop. They have seen water boil and disappear. They have seen mothers make cakes in which a number of ingredients have been used. Children have eaten the final product which neither tasted nor looked like any one of the ingredients. Most children have mixed water and flour together and obtained a paste which is unlike either the flour or the water in its stickiness.

The concept of change is one of the most important concepts in science because it is the natural

order of events. The child and his environment are in a constant state of change. If a child is to understand himself and the environment in which he lives, he needs to understand the changes within his own body and the changes in the living and nonliving things in his environment. A child's understanding of these changes begins with a description of them. Primary grade children are "describers." Intermediate grade children can explain as well as describe some of the changes and some of the causes of the changes they experience as they live in their communities. They can begin to sense the meaning of the great scientific attitude, nothing changes unless something happens to make it change. Junior high school students can describe and explain. In addition they can begin to understand the relationships between living and nonliving things and the effect of these relationships upon the changes that take place.

The selection of the theme of change gave organization and purpose to the elementary science program. The program was conceived as one in which the experiences of boys and girls in science should continually add meaning to the concept of change. The theme is applicable to out-of-school experiences as well as in-school experiences. It is a directive for observation, questions, and study by boys and girls in the elementary grades, and by scientists and laymen as well. Questions of adults are often evidence of the interest in this theme. People are interested in the changes that are taking place about them and in the reasons for the changes.

The Major Generalizations Related to the Theme of Change

The group of teachers studied science subject matter and developed generalizations related to the theme of constant change. They selected the generalizations that could be taught about in each grade level. They believe the generalizations are important for children to have some understanding of in each grade and that the generalizations should increase in meaning as children move through the elementary school. The following list of generalizations were selected:

I. Each living thing changes during its life span.
   - A. Living things grow during their life spans.
   - B. Living things struggle for existence during their life spans.
   - C. Man can affect the relationships between living things and their environment.
   - D. Some animals live in social groups in which there is cooperation and a division of labor.

II. The universe is in a constant state of change.
   - A. Some plants and animals no longer exist on the earth.
   - B. Some plants and animals have changed and continue to exist on the earth.
   - C. The earth's physical features are constantly changing.
   - D. The parts of the solar system are in constant motion in relation to each other.
   - E. The parts of the universe outside the solar system are constantly changing.

III. All changes in the universe are the result of changes that take place in matter-energy.
   - A. Most matter is made of elements and compounds.
   - B. Energy exists in many forms and causes changes in matter.
   - C. Man uses machines to make work easier.

The Specific Concepts That Help Explain the Generalizations

The ideas of the generalizations are so large and demand so many concepts to understand that one teacher in one grade can only make possible some activities that will help children develop concepts essential to the understanding of the generalization. When a person has many, many concepts it is possible for him to understand the relationships among them. As children develop many concepts about the changes that take place in the life spans of specific animals and plants, they begin to realize that all living things have life spans. As they learn about the young of many kinds of animals, they discover that all animals have young, that all animals come from animals, that the young grow and develop, and that adults have characteristics that distinguish them from their young. Each of these ideas is important for an understanding of the changes that take place during the life span of living things. One teacher cannot do the whole job of educating in science, but each teacher can do a part of the job. As teachers work together to help children develop specific concepts related to major generalizations and a general theme the elementary science program begins to have meaning, purpose, organization, and sequence.

Since the number of science concepts that might be taught is greater than any one teacher can teach, she has great freedom in selection of the concepts. They can be selected in relation to what children already know, the books available, the materials available, the community in which the children live, and the important current interest of the boys and girls. A science program based on a

general theme and a few major generalizations is not dependent on any one series of textbooks nor does it mean that one cannot use a series if it has been adopted by the school. No specific concepts have to be taught. The teacher can forget her fear of insecurity generated by rigid programs which she has not been trained to direct. Any teacher who feels the need of helping children learn science can do something important in providing some experiences for children that help add meaning to the basic generalizations important for them to understand. As teachers have the opportunity for more training and more help in the field of science, the experiences and the concepts they help children develop will increase in meaning and significance.

The selection of science concepts can be made from an elementary science textbook, from the teacher's experiences, or from current events in the community. The teacher has only to ask three questions:

1. Will the concept contribute to an understanding of the life spans of living things?
2. Will the concept contribute to an understanding of the changes on the earth or in some other part of the universe?
3. Will the concept contribute to an understanding of the changes that occur in matter-energy?

Examples of some specific concepts about matter-energy are listed below.

III. All changes in the universe are the result of changes that take place in matter-energy.
   A. Most matter is made of elements and compounds:
      1. Specific Concepts
         Grade 1 Some things are made of many things.
         Grade 2 Some things can be changed.
         Grade 3 Some things can be changed into other things.
         Grade 4 There are a few elements in the world and many compounds.
         Grade 5 Atoms and molecules are matter.
         Grade 6 Atoms and molecules can be changed.
         Grade 7 Atoms can combine to make molecules.
         Grade 8 Atoms can be changed to release energy and to make different atoms.

Activities To Help Children Learn Specific Concepts

The teachers wrote activities for each grade level that they believed would help children develop concepts important for an understanding of the major generalizations. Examples of these activities are printed below:

I. Each living thing changes during its life span.
   A. Living things grow during their life spans.
      1. Plants grow during their life spans.
         Grade 1—Plant some grains of corn in a can or flower pot. If a can is used, punch some holes in the bottom for drainage. Fill the can with good soil. Plant corn one-half inch deep. Keep moist. Keep in the sunlight.
            1. What did we plant?
            2. What has the seed done?
            3. How is the plant changing?
            4. What is the plant doing?
      2. Boys and girls grow—
         Grade 4—At the beginning of the school term fasten a sheet of cardboard or plain paper securely to the wall. Allow one to one and a half inch column for each child in the room. Measure the children individually. Mark the height in each individual's column. Also weigh and record each child's weight in his column. Do this once a month. By spring the child can look at his column and see how much taller he is and if he has gained in weight.
            1. How have you changed?
            2. How long did it take you to change this much?
            3. What have you done?

III. All changes in the universe are the result of changes that take place in matter and energy.
   A. Most matter is made of elements and compounds.

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METALS IN WORLD AFFAIRS

By J. O. DERRICK

THE CHALLENGE of our time is found in the unequal and limited distribution of raw materials in the earth's crust. Seventy-three of the ninety-two naturally occurring elements constitute only 0.47% of the face of the earth. Even Gulliver in his travels found this "error of nature" to be a real cause of wars.

Expert metal workers were known in Egypt prior to 3000 B.C. "Ores were smelted, wires drawn, sheet metal fabricated, and the art of casting was in a high state of development. Embossing, engraving, inlaying and enameling of metals were practiced with a skill in some cases comparable to the work of today" (10).

The Romans knew how to harden steel both by quenching in water and in oil. The Aztecs were using knives of iron when the Spaniards invaded Mexico. Damascus blades of the Middle Ages were imported from India. When Caesar invaded Britain he found the people using iron as well as gold and copper for money. The problem of metals, however, was introduced with the Industrial Revolution and has been intensified by the increased use of machines. More metals have been used during the first half of the 20th century than in all previous history. Manufacturing, transportation and communication have been the big users (8). The position of world powers like Germany and Japan during the past generation is more understandable, but their methods just as inexcusable, when one realizes the full significance of their limitations in this respect.

Just as no civilized individual can provide all of his essentials without the aid of society, no nation can survive without interchange of metals. Our nation is in a favored position compared to others. Even so, during World War II we had to turn to fifty-three countries for imports of some sixty different minerals, of which twenty-seven came exclusively from foreign sources. Our sources of twenty of the most vital industrial minerals are as follows: eight of them are 100% imported, six are 85 to 100% imported, zinc and copper are 37% imported, and lead is 44% imported (1). Thus the scientists have a challenging responsibility in trying to inform the citizenship, and particularly our political leaders, of such facts. The impact of such a situation on our way of life must not be underestimated or handled amateurishly by world characters. History seems to move at an accelerated rate. Each successive age has been shorter than the one before it. The stone age lasted several thousand years; the bronze age, 4000 years; the iron age, 2500 years. The recent past has been called the steel age. Modern steel was first made only about a hundred years ago; and we are already moving into an era called by various names, such as the atomic age or that of nuclear power, all associated, as through history, with metals.

The rare metals included in the 0.47% of the earth's crust mentioned above make up a long list of hidden elements used by the average person. He does not realize that he is using them; and therefore, he is not aware of their importance to society.

Three nationally known manufacturers supplied the author with the following information to illustrate the point. Those metals printed in italics are listed as strategic or critical materials or both for stockpiling (14). A washing machine has in it ***aluminum, beryllium, cadmium, chromium, copper,*** gold, iron, ***lead, magnesium, nickel, silver, tin*** and ***zinc***. A television picture tube contains ***aluminum***, barium, calcium, ***cadmium***, cerium, ***chromium, copper, cobalt, columbium***, gold, iron, indium, ***iridium***, lithium, lanthanum, ***lead, magnesium, manganese, nickel***, potassium, ***platinum***, selenium, silver, strontium, sodium, ***tantalum***, thorium, ***titanium, tin, tungsten***, uranium, ***zinc***, and ***zirconium***. An automobile contains about seventy different kinds of steel. Sixteen of the twenty-eight most important materials in a modern four-door sedan are metallic. Almost all of the metals go into its manufacture. Chromium, nickel, copper, tin, zinc and cadmium are big names in the electro-plated parts (15).

One of the significant problems involved in the use of metals is that an extremely small amount in an alloy may make the difference between a highly useful substance and one that is worthless for a given need. For example, the amounts of metals in an automobile vary from about an eighth of an ounce of tungsten to 2500 pounds of iron (15). A thousandth of a percent of tellurium added to iron reduces the time required for annealing by one half. Small amounts of beryllium increases the fatigue limit of springs enormously. Thus most

Timely indeed is this article by Professor J. O. Derrick. Timely because within a month (Dec. 2-4) there will be held in Washington, D. C., the first large-scale conference of conservation, agricultural, educational, and other groups for a consideration of the country's resource problem as a whole. This meeting will be conducted by Resources for the Future, Inc., a nonprofit organization operating under a grant of $150,000 from the Ford Foundation. According to its president, Dr. R. G. Gustavson, formerly president of the University of Nebraska, the conference will seek to "point the way" to policies and actions which will safeguard and promote the national interest now and for future generations. Incidentally, the National Education Association will be represented in the conference by way of NSTA's Executive Secretary.

Associate Professor of Chemistry at East Carolina College, Greenville, North Carolina, Mr. Derrick has AB and MS degrees from the University of South Carolina; is now completing a PhD at the University of North Carolina; during World War II served as chemist in the Fine Products dehydration plant. Besides his special interest in nonfuel minerals, he likes to garden and fish. Another hobby, he says, is his family—Mrs. Derrick and three children.

metals are used as alloys. There are, however, some metals that must be extremely pure. One hundreth of a percent of phosphorus lowers the conductivity of copper about twenty percent and, if tolerated, would increase our electrical bills accordingly. There are forty-five metallic elements and some 8000 alloys of those metals in commercial use (8).

It has been estimated that the life of United States' ore reserves, if production continued at the 1950 rate, would be: Magnesium, millions of years; iron ore about 60 years; aluminum, copper and zinc, about 16 years; nickel, 5 years; and lead, only 3 years (21). America is becoming more and more an importer of metals. American capital is turning to Labrador, Venezuela and Brazil, where enormous iron ore projects are under way. "Increased production, use of substitutes, and improved stockpile situations contributed to a better balance in the metal industry between supply and demand" during 1952 (3). But, there are problems ahead. "Little-known metals with strange names, formerly laboratory curiosities, are now finding practical applications, improving common metal alloys or in metallic form" (18). Historically only a few metals were used. A great diversity of those that were laboratory curiosities 10 to 20 years ago is common today.

Some details on several elements will help illustrate this position of metals in world affairs. Of the less common metals the following are among those which have made news during the first six months of 1953. With the exception of antimony and cobalt, they were only incidentally mentioned in the general chemistry text studied by the author in 1924-25. Except for the above two, practically no industrial uses were mentioned for them. "Textbook of Chemistry" by Mack and others was freely used in organizing the data now presented.

Antimony

Antimony was used in medicines and cosmetics before the time of Christ. The United States lost access to the world's best source when the communists absorbed China. At present good sources of ore are Bolivia, South Africa, and Mexico. The only major antimony smelter in the United States has closed down because over production in South Africa forced reduction in price from 50 to 25¢ a pound (12).

The alloys of antimony have the unusual property of expanding on solidification. They are used chiefly for storage battery plates, type metal, and bearings. A new use for it is in transistors. Its compounds are used as medicines and mordants. It is extracted from its ore by reduction with iron or by roasting followed by reduction with carbon.

Beryllium (1828)

Beryllium occurs in beryl, which is a beryllium and aluminum silicate, and in aqua marine. When beryl is transparent and green, it is called emerald. It is in the family of elements with magnesium, being the element with smallest atomic number. It is the most recent and one of the lightest of the industrially important metals. It is very hard to extract from its ores. Like many other metals it has practically no value as the free metal. It is highly useful to add hardness and strength to metals, to produce almost fatigueless springs, and for aluminum alloys which are very useful in aircraft engines. It has been used as a source of neutrons in nuclear reactions. Its compounds are useful as refractory materials, in some dental cements, and as a coating for fluorescent lights. Considerable effort is being made to locate beryl bearing ores in Colorado. The greater part of our supply is imported from Argentina and Brazil (10).

Cadmium (1817)

"Until recently the chemistry of cadmium has been of academic interest" (11). It came into

prominence a few years ago as the metal used to absorb neutrons in atomic reactors. It is found in small amounts associated with zinc ores in the United States, Mexico, Canada, and other places. A generation ago it was a waste product from the zinc industry. It looks like zinc and is used in low melting alloys. Recently it has become useful for bearing alloys for high speed machinery, as a base for silver plating, and in competition with nickel plate. Possibly the most important compound is the sulfide which is used as a yellow pigment.

Cobalt (1735)

Cobalt is one of the 7 materials listed by the Munitions Board in September, 1952, which were inadequate in supply to meet mobilization requirements. The word meant little or nothing to the average person until very recently. A few laymen might have known of its use to color glass blue and to make certain types of steel. According to newspaper reports, it was the first material to be put under virtually complete allocation by the National Production Authority at the beginning of the Korean War.

It is found associated with arsenic and sulfur in complex minerals containing other metals. The richest deposits are in Ontario, where there is a town named for it. It is also found in South Africa and in Idaho. It is 94% imported (5). Some of its alloys are very acid resisting. It finds its way into airplane exhaust valves, paints, varnishes, linoleum, television, refrigerators, washing machines, radar, magnets, and is used to bind enamel and porcelain to steel, and as a surgical material.

Columbium (1801)

Columbium is another of the seven materials listed by the Munitions Board in September, 1952, which were inadequate in supply to meet mobilization requirements. The first pure specimen was obtained in 1906. The first quantity production was in 1929. It is the same element as niobium. Columbium is very similar to tantalum. Both metals resemble platinum or polished iron in appearance. It melts much lower than tantalum. Both are highly malleable. The carbides of both metals are very hard; and, when they are added to steel, the hardness is increased to make steels suitable for cutting tools. 99% of our requirements are imported. A research project to obtain columbium as a by-product from titanium extraction from brookite is being watched with interest (2). In 1952 columbium and tantalum were both critically short.

Defense Material Procurement has appointed a fourth purchasing agent for acquiring columbium-tantalum ores. The ores are to be stockpiled and distributed for defense purposes. The program is to continue until December 31, 1956, or until fifteen million pounds have been purchased (9). Present workable sources of ores are Nigeria, Uganda, Nyasaland, Norway, Germany, and Rhodesia (12). Columbium goes into jet engine and gas turbines.

Gallium (1875)

Gallium is a liquid metal of the aluminum family, existing in amounts about the same as lead or molybdenum. The richest source is germanite, which contains about one per cent gallium. Flue dusts from certain coals contain it. It may be recovered as a by-product in the extraction of aluminum. Another source is the residue from distilled zinc, which may contain as much as a few ounces of gallium per ton. It is a shiny white metal that alloys easily. It alloys so easily with aluminum that the action may be demonstrated by drawing a piece across a sheet of aluminum. The variation in electrical resistivity is thought to be greater than for any other metal. It is approximately twice as expensive as gold, the price depending partly upon quantity. Perhaps the oldest use was in thermometry for measuring temperatures above the boiling point of mercury. It is being used in gold alloys for dental work. The fact that it expands on freezing suggests its use in castings. It wets most surfaces. It has been used in phosphors for fluorescent lights and in luminous paints. It has a high thermal conductivity, and a low vapor pressure. Cost and availability are great obstacles in the way of its wide usage (20).

Germanium (1886)

Germanium, the metal of transistor fame, is a rare member of the silicon family, currently selling for about $350.00 per pound. It occurs to the extent of about 0.01% in many United States zinc ores and is also obtained from certain coal ashes. Dr. Hans Brauchill of Johns Hopkins has found that the ash of some plants, mostly from swampy areas near mountains, contain as much as 5% germanium. Apparently the plants "discard" the metal by depositing it in the leaves and bark. It is brittle and crystalline. Its compounds resemble those of tin. In its crystal form it is used in radar and television receivers. It is known as a semiconductor. It changes alternating current into direct current. In addition to being a rectifier, it is an amplifier. It can oscillate as well as amplify. Because of this, it can be used to produce standard frequency tones.

The General Electric Company has reported that more than one hundred germanium junction transistors can be made from a six inch ingot. A new process "can grow junctions with much smaller impurity concentration gradients than are produced by other techniques. The process should be in production in about a year. It is expected to cut the cost of processing germanium by several times, improve performance, and permit use of transistors for the first time in television sets" (19). Each of the transistors contains a layer of germanium mixed with a trace of gallium, separated by thick regions of germanium containing small amounts of antimony. The first section replaces the grid in a vacuum tube; the second layer, that of the cathode and plate in a tube.

The rapid pace being set in the metals industries is indicated by predictions that germanium transistors may be replaced by an intermetallic compound of aluminum and antimony. Germanium as a transistor metal was introduced only as recently as 1948. Already the metals industry is involved in world problems trying to supply metals with which to alloy it for various purposes. Among those used to make N-type semi-conductors are copper, silver, magnesium, calcium, zinc, strontium, cadmium, barium, titanium, tin, lead, vanadium, columbium, tantalum, bismuth, chromium, uranium, cobalt, nickel, and palladium (6).

Germanium forms an oxide which, like glass, can be drawn out into needle-like objects into which radio-active gold may be placed and inserted under the skin where the gold is needed. It dissolves harmlessly in body fluids leaving the gold in place (7).

Iridium (1904)

Iridium is a very hard and brittle metal that looks like silver and is not oxidized at high temperatures. It is resistant to aqua regia. Iridium is one of the six so-called platinum metals, all of which are listed as critical and strategic. It is more expensive than gold. It is used as a hardening agent for platinum and other alloys. A common use is in fountain pen points. It is found in very small amounts in the United States, Canada, Columbia, British Isles, Russia and South Africa.

Tantalum (1820)

Tantalum is rarer than gold. It was first successfully used as a filament for light bulbs, but was

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THE STUDENT IN NSTA

By ALBERT W. EDGEMON

Student, University of Florida, Gainesville
President, Florida Association FTA, National Association FTA

"MEMBERSHIP DUES, including publications and services, $2 Student (. . . $1.50 is for Journal [*The Science Teacher*] subscription)"

This statement, found on page 267 of this issue of *The Science Teacher*, is an indication of the value the National Science Teachers Association places on your participation as a student preparing to teach science. It is your invitation to begin taking part in the organized teaching profession.

Why does the NSTA make provision for you to hold membership with full privileges, including voting? The NSTA, and many other education associations, recognize the advantages which you receive through membership in a professional organization while you are still in college.

Should you take the NSTA up on its offer? Yes, by all means, and here's why! You learn how the organization is conducted, who leads it, how it meets in convention, what it does, and what value it is. You meet its leaders and find out how they became leaders. You profit by cooperative action with other student members. When you have graduated, you are able to take your place immediately within the association, to give your services and talents to it, and to help assume the leadership of it.

The NSTA is a department of the National Education Association, the all-inclusive association for all educators. Most NSTA members are members of the NEA. The NEA and the state education associations sponsor the Future Teachers of America, the all-inclusive association for students preparing to teach. You as a student member of NSTA will want to hold membership in your local FTA chapter and, through FTA, in your state education association and the NEA. Thus, you will be receiving, along with many thousands of students in America, experiences in your local, state and national education association, and in your own special-interest association, the NSTA.

It is within your FTA chapter that you will have many of the experiences with other student members of NSTA and student members of other education associations. As a member of FTA and NSTA you may attend FTA chapter meetings which are of interest to all students preparing to teach. At the same time you, and the other NSTA student members on your campus, may carry on projects of special interest to you as science education students.

Are you wondering how you will find time to belong to all of these organizations and to attend all of their meetings? Actually it is not complicated or time consuming. Ideally, all students preparing to teach will belong to FTA, and through FTA, to the NEA and their state education association. At the same time they will be a part of their special-interest association. Since you are a science education student you would be a part of the students within the FTA chapter who are going to teach science, and a member of the NSTA. All FTA members would meet together for the chapter program. During this meeting each special-interest group would have a chance to meet for a buzz session to discuss and to plan their special projects and activities. Then the entire group would participate in the program which had been planned by representatives from FTA and each special-interest group. Thus, one meeting serves all student members of education associations. This avoids the time consuming plan of each group holding a separate meeting; but at the same time this protects the identity of each group.

You may also be wondering how much membership in all these organizations is going to cost. It is not expensive in relation to what you receive. NSTA student membership is \$2.00. FTA membership is \$2.00, which includes \$1.00 for membership in the NEA, and \$1.00 for membership in your state education association. Local chapter dues may be charged, but this varies from chapter to chapter. All this adds up to only \$4.00 plus local dues. These membership dues enable you to receive the experiences mentioned previously and the Journals which the three associations publish. These Journals, when collected and filed, make an excellent library to use when you begin teaching.

You will enjoy your experiences in NSTA and FTA. What's more you will take part in activities which will help you to be a better teacher, and which will help you to be a better member of the organized teaching profession. Students all over America are participating in these experiences. Accept this invitation as your opportunity to join NSTA and FTA today, for tomorrow you teach.

STORY OF A GEYSER MODEL

By JAMES R. WILSON

Instructor of Earth Science, Phoenix Union High School, Phoenix, Arizona

ABOUT 25 years ago here at Phoenix Union High School, a student of mine in physiography, named Jimmie Hall, asked me if he might build a geyser model as a project for credit in the course. He said, "I believe I can make one that will work." I replied, "I think that it is a fine idea and I will get you some sketches and material to read."

A few weeks later Jimmie came in one day with an old dish pan with a tube running down through the bottom and terminating in and sealed to a tin can with a screw cap on the top of it. He set it up on the demonstration table on some ringstands, filled the can with water, and placed a lighted Bunsen burner under it. Within a short time a little water spouted up from the tube, followed by a few spurts of steam and ending in some gurgles and rumblings, before dying down. *We had a geyser.*

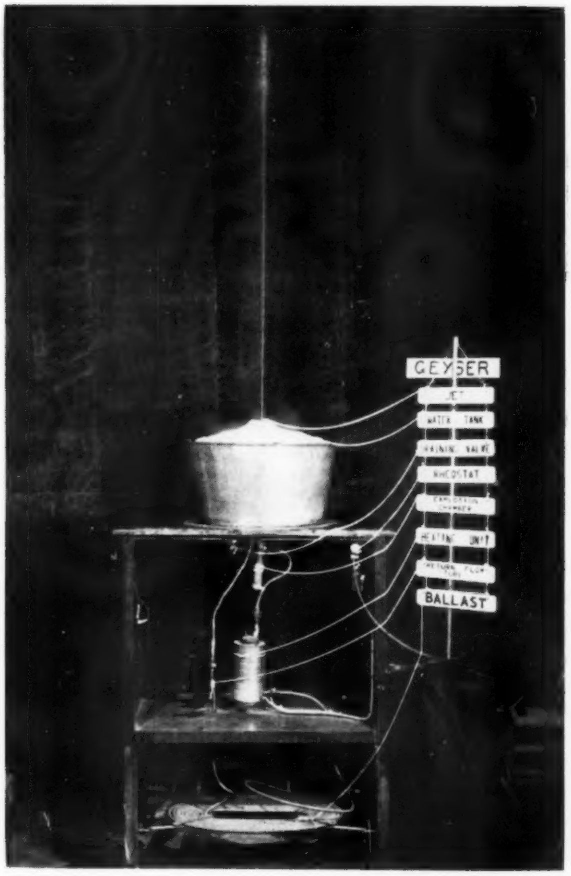
It was true that after a time or two of sending a little water four or five inches up from the tube, the device subsided to steaming as the water in the can boiled. Strangely enough I kept the device around for a number of years and dragged it out each year when we studied geysers to show what Jimmie Hall had accomplished by a bit of initiative. Finally I became interested in the possibilities of a model that would operate continuously and without attention. So when the old dish pan rusted out I had Mr. J. J. Kayetan, head of the metal shop of our school, make a large tapering copper pan for a water supply. Mr. Henry Heidenreich in charge of our wood shop built a table 3½ feet high and about 2-ft. x 3-ft. on top, to hold the pan. A tube was run from near the top level of the pan through the bottom and about two feet below, was made fast to a heating chamber, and then run out of the side of this chamber near the lower end and returned upward, being pushed just through the bottom of the pan and soldered to it. "Now," I said, "I've got me a geyser model that will work." But it didn't do much better than Jimmie's original model, except to send up a higher column of water. It got hot and simmered. It failed to give a realistic, pulsating explosion.

Here is where a steam engineer was called to the rescue. Mr. Ira C. Lane, in charge of our heating plant for many years, was willing. He said, "Jim, I can make that geyser spout to this high ceiling and keep it going all day." I didn't believe a word of it but said, "OK, it's your baby from here on."

While I had been playing with this piece, the years had been slipping away. I spent a little time each year on it as I brought it out to demonstrate to the classes. Each year we discussed in class the problems involved and the students made suggestions for improvement of the model. It was slow business and we didn't make much real progress until Mr. Lane entered the picture.

He made an explosion chamber between the pan and the heater, and this produced a good pulsating explosion several feet high. After a month or so of experimenting in his spare time, he called me over one day. With a gleam in his eye, he said, "Watch this." A fine thin column of water shot from the

A typical eruption with single opening jet



model to the ceiling about 20 feet up. I said, "All right, mister, let it run the rest of the day and see how it performs at quitting time." It didn't perform—it just stuttered and sputtered, after about an hour. That was enough for that year.

Next year, Ira got going in earnest on the piece. By adding 50 feet of copper tubing in a flat coil at a specified level below the heater, he solved the cooling problem and improved the type of explosion. The last problem proved to be the heater itself. The head of our electrical shops, W. H. Henry, formerly with G. E. Research, built an electric one that appeared to "go to town" at first. It soon proved inadequate. Mr. Henry knew his electricity as few do, but he didn't know much about steam. Paradoxical as it may appear, Ira Lane had to give Mr. Henry the specifications for the winding of the heater. Mr. Lane didn't know much about electricity, but he knew exactly "how much and where" he wanted the heat applied. Mr. Henry built a heater to these specifications, and presto, we had a geyser model that was well nigh perfect and fool proof. That was some seven or eight years ago and the model has been functioning ever since about three months out of each year, five days a week, from 8:00 a.m. to 4:00 p.m. No attention is needed beyond adding distilled water every day or so. It throws a small column of water about 5 feet high with a pulsating movement and ends in a blowing off of steam. The device occupies a niche in the hall just outside the open door of my physiography laboratory. I can hear it erupting every minute and twenty seconds as I write its history here.

A few years ago we displayed it in a window in three places in downtown Phoenix—a bank, a department store, and the light and power company. To make it more realistic, Mr. W. H. Voigts of the radio shop of our Technical high school, rigged up a mike and speaker for it, so that people on the sidewalk could hear as well as see the eruption. It made a bit of a sensation down town.

I might add that Mr. Henry made us a rheostat for it so that we can vary the interval between eruptions. The piece has possibilities beyond the geyser model concept. If desired, it could be built as an ornamental fountain for a garden, complete with colored lights. The cone of our piece is built of cement and has the contours of Old Faithful.

Mr. Lane and I considered ourselves partners in the project and Uncle Sam gave us a patent on it last November. Oops, thar she blows!

SCIENCE INSTRUCTION OVER COMMERCIAL TELEVISION

By SAM S. BLANC

INDUSTRY AND BUSINESS is pouring millions of dollars annually into commercial television, because this medium has proved itself amazingly effective in advertising and selling. What educators seem to overlook is that if television is so effective in selling commercial products, it must be equally effective in selling education. Students of audio-visual education know that the multisensory impact of both sight and sound is one of the most powerful media in instruction. Television brings this important means of instruction into the home. In a few areas where television is now operating, it is being used to acquaint the community with the educational program being carried on in the schools.

Science has always been a fertile field for visualization. Since television, by its very nature, demands that the viewers see the concepts demonstrated, science offers a natural field for programming. A number of interesting and worthwhile science programs have already been telecast over commercial stations. In fact, as early as 1940, Dr. Francis Norton opened the fortieth General Electric Research Laboratories with a television demonstration of glass to metal sealing over WRGB-TV in Schenectady.

During the war period only sporadic attempts were made to present science programs over the air. Since 1948, however, a number of excellent science telecasts have been developed. One of the most outstanding has been the "Johns Hopkins Science Review" originating over WAAM-TV in Baltimore. One of the oldest and best known of the educational programs, this series has been written by Dr. Lynn Poole and produced by Mr. Edwin Mick. These programs can also be seen in other parts of the country over the Dumont television network. The "Johns Hopkins Science Review" presents the results of current research being carried on by Johns Hopkins University scientists. It has covered everything from aeronautics to x-rays. Scientists from government institutes and other universities are also invited to participate and demonstrate their latest discoveries. Each program has been a condensed presentation of a new frontier of science. Given in a simple, yet exciting form, each program combines education and entertainment for the viewers.

The Philadelphia Public Schools, under the able direction of Miss Martha Gable, have also pioneered in the presentation of educational programs over commercial television. One of the best known of these has been the "Nature of Things" originating over WFIL-TV and now being carried on the NBC television network. With such outstanding men as Dr. Roy Marshall and Dr. I. M. Levitt, of the staff of Philadelphia's world-famous Franklin Institute, illuminating fifteen-minute explorations of seemingly simple facts of universal science which direct our daily actions are shown. Scientific inventions which we use constantly are discussed in an entertaining and instructional manner. Such things as how to whip up a miniature atomic explosion in the kitchen, explaining the solar system with a basketball, and showing how insects multiply under a microscope have been a few of the interesting topics presented.

The New York Public Schools initiated "The Living Blackboard" series in the fall of 1951 over WPIX-TV. The subjects covered included liberal arts and vocational guidance as well as science. Under the direction of Mr. Edward Stasheff, the series was planned primarily for those older students

The educational use of TV and its utilization particularly in the advancement of science instruction are problems that seem destined to deserve and demand our attention on into the future. Dr. Blanc has performed a helpful service in pulling together the information and ideas presented in this article. This was made clearly evident by the questions and interest that developed when he made a panel presentation on the subject at the Rocky Mountain Regional Conference of NSTA at Boulder, Colorado, October 9. Dr. Blanc is teacher of biology and director of audio-visual services in East High School, Denver.

In this connection, we should also like to call your attention to "What to do About TV" by Carl F. Hansen, Associate Superintendent of Washington, D. C., Public Schools. This article appeared in *Educational Trends,* Issue No. 1252; it is available at 20 cents from the publisher, Arthur C. Croft Publications, 100 Garfield Avenue, New London, Connecticut.

who receive home instruction. These are pupils confined to their homes because of illness or other physical conditions which make it impossible to attend regular school classes. Television has supplemented the regular instruction which these pupils now receive from visiting teachers. In addition, the programs have provided televised instruction for children in hospitals, and hospitalized veterans who are completing their high school education. "The Living Blackboard" schedule of programs for March, April, and May, 1952, is included at the close of this report.

G. M. Cunningham, chairman of the Radio and Television Committee of the Southern California section of the American Chemical Society, has directed a weekly program, "The Science Page of the Magazine of the Week," over KTLA-TV in Los Angeles. Members of the A.C.S. from various branches of industry and education have demonstrated the highlights of their various investigations. Such educational presentations as "Chemistry of Make-Up," "The Motion Picture Chemist in Action," and "The Science of Citrus Fruits," have been telecast.

Other outstanding science programs directed at an adult viewing audience have been telecast since 1949. "Headlines in Chemistry" and "Excursions in Science" have originated over KSTP-TV in Minneapolis. A weekly program brought leading scientists before the viewers to discuss and demonstrate the many complicated problems surrounding atomic energy in the "Atomic Report" series over WMAR-TV from Baltimore. WMAL-TV, in Washington, has presented special demonstrations by scientists in the government and other agencies in the area. A few of the better known programs in this series were "Cancer Research in Mice," "Effects of Cerebral Palsy on Children," and "A Lunar Eclipse from the Washington Naval Observatory."

Two NBC television network programs which have been designed primarily for a juvenile audience have been "Zoo Parade," from Chicago's Lincoln Park Zoo, and "Mr. Wizard," an entertaining presentation of some of the wonders of science on a very elementary level.

To be more specific as to the organization of some of the science programs presented over commercial television stations, the program outline for "Seeing Is Not Believing," one of the Johns Hopkins presentations, is given in detail at the close of this paper. The theme, the opening, and the program sequence for seven other programs in this series are described by Poole.[1] The main steps are outlined for every action in the development of each of the following programs so that even without the script the reader can understand what was involved in each presentation:

1. Science of Archaeology
2. Public Health Engineering
3. The World from 70 Miles Up
4. The Science of Medical Art
5. It's the Law of the Universe
6. Flight at Supersonic Speeds
7. The Magic of X-Ray

The production of a successful science program on television takes careful planning, much detail, and hours of work! Worthwhile programs do not materialize on their own, nor can they be thrown together haphazardly. Poole presents a ten-point plan as guide lines in developing a science telecast:[2]

1. Definition of the purpose of the program
2. What form of presentation will the program take
3. Selection of the subject
4. Development of a major theme
5. Selection of visual material for the demonstration
6. Writing the script
7. Planning camera angles and operation
8. Setting the stage
9. Preliminary rehearsals
10. Final rehearsals with camera

It should be noted that practically all the science programs described in the previous paragraphs were presented as straight-forward demonstrations or as combination interview-demonstrations using some outstanding personality as the main focus around which the program was built. Yet, television seems to offer a superb opportunity to show the actual work of boys and girls, with emphasis on the youngsters explaining what they are doing and why. It would also seem that the program would be much more interesting if the children were to carry the show with their own dialogue and explanations. An overly rehearsed presentation soon assumes the unmistakable stamp of being "canned." But a natural, seemingly unrehearsed group of children carrying on their normal activities in a class can be a very fascinating show for the audience.

The number of participants in any one program must be kept to a minimum, however, for the television studio cannot take the place of a regular classroom. Gable suggests that five or six children would be an ideal number before the camera with fifteen about the maximum.[3] Children have a

[1] Lynn Poole, *Science Via Television.* Baltimore: The Johns Hopkins Press. 1950.

[2] *Ibid.* p. 7.

[3] Martha A. Gable, "Teacher! Here Comes Television," *Educational Screen*, 28:68-70, February, 1949.

natural appeal which can give life to any educational telecast. And the importance of attracting a large viewing audience must not be overlooked.

Another means of insuring a large audience for an educational series is to enlist the public in the program. Hock offers several means of accomplishing this.[1] One of the programs could center around the use of parents or laymen as resource people in a science unit, or the public might be appealed to directly from the television screen. For example, in a program on health, one of the youngsters could look directly at the camera and say, "You who are doctors, dentists, or nurses, what can you tell us to help us better to understand this work we are doing at school? We would appreciate it if you would write us or appear on this program to tell us." Another means of stimulating audience participation is to present a program, such as the study of rocks, and ask the viewers to send in specimens for identification on the next program. Everyone likes to hear his name mentioned over the air. Even turning the tables on the viewers by asking them to take a quick "telequiz" over the material presented on the program will arouse interest.

In addition, the public relations aspects of a program must not be overlooked. Programs of actual teaching by teachers and learning by children are, perhaps, the most effective means of letting the community know what the schools are doing. Let us have more science programs showing the class in a real and meaningful learning situation. Let the parents have an opportunity to see what their children are learning. Let us present to the public the newest and best in methods and procedures. Here is a wonderful chance to show pupil-teacher planning, to show students presenting projects that are the culmination of their learning in science, to show the use of audio-visual materials of instruction, and to show real science in action!

As a final statement, however, before anyone goes off the deep end and tries to rush into science programs for a telecast, it must be pointed out that if an educational television program is to accomplish its purpose, it must have certain qualities which will make it both educational and entertaining. Wigren suggests the following criteria.[2]

1. The program should have an educational purpose
2. The program should provide the possibility for continuity
3. The program should present an educational philosophy consistent with democratic values
4. The program should be built upon the needs and problems of the viewers
5. The program should serve as a means of growth and development for the viewers
6. The program should involve the viewer as a participant
7. The program should be a means by which many creative and thought-provoking experiences can come to individuals
8. The program should be presented in an atmosphere of objectivity
9. The program should be flexible in its design and approach
10. The program must communicate clearly and effectively

SEEING IS NOT BELIEVING

The Johns Hopkins Science Review

WAAM-TV Baltimore, Md.

January 7, 1949

PROGRAM SEQUENCE	VISUAL MATERIAL
1. Standard opening and 2. Attack opening	Kettle drums, sound effects Two persons whose eyes can be seen C-U Rubber snake Papier-mache rocks
3. Intro. We are fooled by the simple things we do every day. We do not know how we do these things. How do our eyes work when we read? Explain. Why info. is valuable to psychologists.	Same two pair of eyes used in sequence #2
4. We cannot always believe our eyes. Illusion of coordinate lines. Vertical looks longer than horizontal.	Show-cards with horizontal line crossed by equal length vertical Black top hat—to be worn Scale models of aircraft carrier and Empire State Building
5. The illusion of perspective wherein two lines in the distance look closer together: height of objects appear taller or shorter than they really are?	Perspective photo of a road with guard rails and telephone poles Cut-out of last telephone pole, pasted beside first pole on second photo Photo of two men, one in foreground, larger one in background. Compare

The above program outline for "Seeing is Not Believing" is reproduced from Lynn Poole, *Science Via Television.* Baltimore: Johns Hopkins Press, 1950. pp. 59-61.

[1] Louise E. Hock, "Television Programs for Public Relations," *Journal of the AER*, 12:29-30, December, 1952.

[2] Harold E. Wigren, "What is an Educational TV Program?" *Educational Screen*, 31:420-22, 435-37, December, 1952.

Application of theory

6. Illusion becomes a mental process. People often see things the way they want to see them, not as they actually are. *Desire.*	
EXAMPLE: *Poor children visualize coins larger than they really are. Rich children—in true size.*	Coins Disks the actual size of coins Disks larger than corresponding coins
7. Application of #6. The illusion of seeing things the way a person *wants* them to be is used by psychologists problem of a patient. This often depends on the patients' interpretation of photographs.	Photograph of man and woman seated at a bar. Waiter in background
8. Further development of this point—people (1) see things they will not admit they see, or (2) actually are not consciously aware that they see them. #8 is to show the second fact. *Subject fears heights. Words are flashed in front of his face. He cannot tell demonstrator the word, but he reacts to words about heights.*	Subject (young man) Cards with printed words which he subconsciously fears Psychogalvanometer (PGR), the recording machine Operator of PGR
9. Further development. By seeing, or not seeing and by translation of what they see, people have a conscious or unconscious emotional reaction. This emotional reaction can be caught on a machine. EXAMPLE*: the lie detector.*	Subject (young woman) PGR Operator of PGR List of words to be read by demonstrator
10. The words to which the subject reacted and gave himself away are called the emotionally charged words. It takes him longer to react to the charged words, than to the uncharged words. He does not believe you can see this difference.	Same as in sequence #9 Two recording clocks now attached to PGR—one to record the emotionally charged words, one to record time on non-charged words
11. Re-cap. on seeing is not believing, and the ramifications of psychological effects.	
12. Sometimes the opposite is true. With concentration we can often see more than is visible. Everyone has seen the partial drawings of objects—the eye fills in the missing lines, it perceives these missing lines from past experience of seeing like objects.	Four cards. One each of a partially drawn object
13. Audience can receive correct answers of the identification of four cards in #12 by writing to	Poster giving address
14. Preview of next week	

WNYE

BOARD OF EDUCATION CITY OF NEW YORK

29 Fort Greene Place, Brooklyn 1, N. Y.

"THE LIVING BLACKBOARD"

BOARD OF EDUCATION TELEVISION PROGRAMS OVER STATION WPIX, CHANNEL 11

"Science at Your Fingertips"—Mondays at 12 Noon

March 3—BACTERIA—FRIENDS OR FOES
with Louis Kleinman
" 10—TRAVELING IN THE BEST CIRCLES (Rotation and Revolution of Earth)
with Dr. Alexander Efron
" 17—HOW LIFE BEGINS, with Louis Kleinman
" 24—MORE ABOUT THE WEATHER
with Alfred D. Beck
" 31—HOW LIFE CONTINUES
with Louis Kleinman
April 7—OUT IN SPACE (Stars, constellations, meteors and comets)
with Dr. Alexander Efron
" 14—EASTER HOLIDAY—No broadcast
" 21—THE FLOWERS THAT BLOOM IN THE SPRING
with Louis Kleinman
" 28—INSIDE TV, with Alfred D. Beck
May 5—LIKE FATHER, LIKE SON (Heredity)
with Louis Kleinman
" 12—YOUR EYE IS A CAMERA (The eye and the camera); with Dr. Alexander Efron
" 19—DEAD AS A DOORNAIL (Fossils)
with Louis Kleinman
" 26—A MESSAGE FOR YOU (The telegraph and telephone); with Alfred D. Beck

SCIENCE PROVISIONS FOR THE RAPID LEARNER —*a Symposium*

Coordinated by SAMUEL W. BLOOM

(Continued from the October Issue of *The Science Teacher;* Concluded)

Donald A. Boyer, Skokie Junior High School, Winnetka, Illinois, describes how the Winnetka Junior High School enriches its science program.

"Skokie Junior High School receives all sixth, seventh, and eighth grade students from the three lower schools in Winnetka. All seventh-graders take a one-semester course in general science, meeting five periods per week. This course is taught by teachers with special training in science education and in early adolescent psychology. No one science teacher has more than two such classes on his schedule; thus the factor of monotony in the teaching day is minimized.

"Science classes are moderate in size (25-28), and the teachers soon come to grasp the array of differing capacities and interests of their charges. The course is flexible and non-prescriptive in content, so that each teacher has freedom to help the pupils take on many individual and small-group projects. Furthermore, the brighter students who finish the basic work sooner are encouraged to put their extra time to use in developing their own projects.

"The science equipment and room set-up, while not lavish, nicely facilitate small-group activities. There is the science classroom containing demonstration desk, sink, and adequate area of work tables: but also there is a science laboratory adjacent to the classroom. In this laboratory students may set up their projects and often leave them set up for several days or longer. The young radio enthusiasts and the embryo chemists in a group will often find that they need to have the impedimenta of their experimental pursuits left untouched for a number of days. (The teachers feel that the scientific method is not fully appreciated when constantly hemmed in by period bells and once-performed science activities.)

HOW THE WINNETKA JUNIOR HIGH SCHOOL OFFERS ENRICHMENT

"Class assignments, when they have to be prescribed, always include suggestions for 'fast workers' to undertake further reading, to develop extra experiments, or to write up more complete data. The science room has a special card file of 'original' and 'semi-original' experiments developed by students over the years, bearing their signatures and the teacher's O.K.

"After a seventh-grader has taken the semester of general science he is technically free of further science work in the junior high school. However, three additional curricular features are designed to attract all students, but especially to entice those boys or girls with special interest and high abilities. First, through the school's scheduling one science teacher with a 'Science-social studies free period' each day, any individual or small group of youngsters may come from their social studies classes to seek this teacher's advice and to develop correlated science projects growing out of their social studies activities. Second, there is a science club called the 'Research and Production Company,' which is one of fifteen similarly organized co-curricular activities in the school. It meets three days a week during the last period of the day.[1] Finally, an elective 'advanced science' course is open to all students after they have taken the semester of general science. This last-mentioned feature will bear describing more fully.

AN ELECTIVE ADVANCED SCIENCE COURSE DEVELOPS FURTHER INTEREST

"The enrolment in any one 'advanced science' class is limited to twenty. The group meets in the smaller science room, 'the lab,' for five periods a week. As the semester begins, the members are asked to fill out a questionnaire which contains a descriptive list of suggested study areas. Each student ranks the topics according to his own order of interest; and he may write in and rank topics not listed. The teacher then collates the data, and, after group discussion, starts group classwork on the most frequently checked topic. In this way, our 'advanced scientists' develop a group sense and also the instructor has time to observe individual capacities and interests.

[1] Donald Allen Boyer, "Adventuring with Little Corporations: III." *The Clearing House.* 20:77-79; October, 1945.

"As the semester's work proceeds, increased opportunities for individually created science learnings are provided. Using the same philosophy described above for the beginning course, the teacher allows his students to spread out, and leave set up as much of their work as the problem-solving situation demands. In addition, small-group demonstration experiments, hall-case exhibits, reports on special science topics or gadgets—all these devices are employed to enrich both individual and group learning.

STRESS IS PLACED ON INDIVIDUAL WORK

"During the last six to eight weeks of an advanced science class, a visitor might enter the science lab on 'free-work' days to find a variety of pursuits actively in progress: One young scientist is sitting alone, peering through a microscope at his culture of one-celled organisms. At a nearby table, two thirteen-year-old girls are preparing a joint report on 'How We Extracted Gluten from Flour.' In the middle of the room the majority of the class are seated, quietly memorizing their radio-style script entitled 'Winnetka's Water Gets Safely to Our Homes.' Needless to say, the teacher's energies put a natural limit on the variety of such work progressing at one time; but once the technique is patiently tried, teachers find it worth the effort.

THE SCIENCE CLASS PROVIDES FOR MALADJUSTMENTS

"Not all the students choosing advanced science in the school are high I.Q. children. Our school faculty strongly adheres to the philosophy of a many-sided array of valuable qualities making up any human personality. But, needless to say, the gifted child who is a 'problem' many other places in school or at home, will in a gratifying number of instances, gain a new and wholesome lift in his attitudes toward intellectual activity through the opportunity to use his developing talents invitingly and busily in the science class.

"One further feature of the school's curricular philosophy protects this enrichment value in a vital way. A student may not—except under extreme conditions—be 'pulled out' of his elective class because he may be misbehaving or behind in *other* classes in the school. Rather, the faculty understands that the bright child will be more likely to solve his general school difficulties if his few areas of 'full living' are kept inviolate. We as teachers, frequently reap the vicarious rewards that come from adherence to this policy. Young research scientists, doctors, nurses, and even adult science

hobbyists come back to us after the years, to give testimonials on the sparks that were lighted and kept glowing 'in those days in the lab.'

"In the foregoing paragraphs, an attempt has been made to express inductively what might be expressed—if somewhat compactly—in a deductive generalization. The kind of program in junior high school that will promise most for the development of bright children in the area of science, calls for teachers who (1) try to understand the developmental needs of early adolescents; (2) have studied the major areas of general education science; and (3) are courageous enough to enlist, by cooperative and democratic processes, the help of their fellow teachers in facilitating a flexible, pupil-teacher-planned science program which enhances the use of problem-solving methods in the classroom."

Concluding Statements (by the symposium coordinator):

From a study of these reports describing the provisions being made for the rapid learner, certain inferences and conclusions may be made:

1. Identification of the rapid learner is essential if we are to provide the stimulating background necessary for his growth.
2. Subject matter of increasing difficulty must be provided to furnish challenging situations and to encourage the student to work to his highest capacity.
3. The generous use of the library and supplementary materials are indicated to create a keen interest in science.
4. It is desirable that provision be available for extra laboratory work and the opportunity for creative project work.
5. Participation in science club work, the NSTA Science Achievement Awards program, the Westinghouse Science Talent Search, and local state, and regional incentive programs is necessary to maintain interest in science beyond the basic work of the course.
6. Use of community resources, outside speakers, attending lectures, "open house" at colleges, expositions, visiting local industries, field trips, etc., are all facets in providing for the enrichment of the regular science course and a "must" for rapid learners.
7. Reading reports and the science-writing aspect on items of special interest are necessary to increase the wide range of activities of the rapid learner.
8. The rapid learner can work with more freedom and should assume a greater responsibility for his own school activities.
9. Opportunity should be given for small-group committee reports within the area of their particular interests. Gifted children enjoy working in groups and like the opportunity of sharing experiences.
10. Hobby activities should be encouraged.
11. Preparation of charts, diagrams, flow-sheets, microscope slides, plaster casts, specimen collections, all increase the range of activity of the youngster and may become part of the permanent teaching collection.
12. Vocational aspects of science should not be neglected. The rapid learner should be given every encouragement and consideration which will enable him to wisely select his vocation.
13. The science laboratory or room should be different from a regular classroom. It should be a place where science materials are available and are used. It should be a pleasant place in which to work and functional in its arrangement. It should have a stimulating effect on the child.
14. Participation in local radio and television programs increases the scope of activities.
15. Opportunities to assist the teacher in the capacity as laboratory assistants or "science dispensors" give the rapid learner the feeling of constructive action and a sense of participation.
16. A close relationship between a teacher acting as a science advisor and the rapid learner is usually productive in the more advanced areas of knowledge and encourages the student to extend himself.

Paul Klinge, Thomas Carr Howe High School, Indianapolis, Indiana, describes a mid-western approach.

"It must be pointed out, initially, that *identifying* potential science students is a process that is bound up with *helping* such students, both as to definition and method. For the student who is identified is helped. Yet the process of helping students, with all its ramifications, enables the identification to be made. The real student—and that is the one we are after—will respond to extra help and thus identify himself to himself and to the teacher as a potential scientist.

"Thus identification is another instance of the old saw: that interest precedes study and interest is built up by knowledge. The missing factor in this circular process is the response of the student. And that is hard to predict and delineate.

"The program in my school has, I believe, one outstanding feature. This feature is its simplicity. It is a program which can be duplicated in most high schools. It was done with a minimum of curriculum organization, and interminable administrative discussion.

"The science program at Howe consists of tenth-grade biology, eleventh-grade chemistry, and twelfth-grade physics. There is no ninth-grade science course. In addition to the above courses a non-laboratory science course has been initiated called physical science. This was aimed at the student who takes the required year of science in biology and misses the regular physical sciences. The first semester of this course is a combination of physics and chemistry and the second semester takes up the sciences of meteorology, astronomy, and geology. Chemistry III and physics III are offered every year that building space permits. The crowded condition of the school precludes any further curriculum expansion.

"The identification of potential science students is made in the first semester that they appear in the biology class. At the end of the second grading period in the fall semester each biology teacher submits a list of names of the students who will be taking the spring semester and who fall into one or more of these categories:

1. Those who plan to major in science
2. Those who plan to minor in science
3. Those who are making the top grades
4. Those who show an unusual aptitude or interest in being in a special class

"The students in the above categories who give their assent are put into a special biology class for the spring semester. The course of study for this class follows approximately the same timing and precisely the same sequence of units as any other biology class in the school. However, each student is required to work on a semester science project, and the class is given more field trips off the campus than the other classes. In addition, there is a great effort made to tie up biology with the other sciences and the vocational possibilities of the field. We have about ten to fifteen distinguished speakers talk on their field of special interest when that subject comes up in the regular course of study.

"To prevent the label given to the class of 'too hard and too much,' which would cause most typically American students to shy away from such a setup, some of the paper work usually so necessary in a regular class to encourage study and reading is dispensed with. Time is given in class for project work. There is a constant hammering away at the theme that the project should represent a consistent field of study that involves some laboratory work with a collection of data, as well as research into the literature on the topic. There are no bibliophilic research reports which represent beautiful library work but little if any primary collection of data.

"At the end of the semester the students are beginning to get some idea of their potentiality in science, if any. The student is shown the drudgery as well as the bright spots of the scientific career. The prospects of awards in this field of science offer incentives which cannot be duplicated by the classroom teacher.

"Once these students have decided to major in science and to do more than simply take the required three years, their progress is watched and encouraged by the head of the department. Each student is told to attach himself to one science teacher who shall act as his advisor. This teacher then has the responsibility of encouraging to the limit of his own ingenuity the student who has asked for his help. Nothing, by the way, seems so flattering to the teacher as to have a student voluntarily ask for his help when he has seven possible choices. As freshmen, sophomores, and juniors, they are encouraged to enter the Science Achievement Awards program of NSTA's Future Scientists of America Foundation. When the student is a senior he is encouraged to prepare an entry for the Westinghouse Science Talent Search. Prior to this he is asked to prepare a paper for the Indiana Junior Academy of Science. Such entries make the stu-

dent crystallize his thoughts, and in so doing, recognize his deficiencies. We have found that this encourages further study better than any other method. When a paper can be submitted to the teacher, and then the teacher gives it his critical comments, the student is helped as in no other way. But no teacher is ever guilty of writing such a report. This, of course, is simply not good ethics, but we do feel free to criticize the paper rather sharply.

"This program for identification is all bound up with the observation of the student in the tasks given for his study and research, and in the responses he shows to the special interest-creating tricks of speakers, field trips and projects. As long as the student keeps showing the interest to pursue the work still further, and still more intensively, the teacher is then in the process of identifying, tentatively, the potential science student for the universities. The program of help for these students is all a matter for the teacher and community to open up the avenues available and to make them possible for his untrammeled use. When we found a student interested in mycology, we not only found the men interested in that field in the city, but we made arrangements to visit the mycology laboratory in the local city hospital. We found the universities who had men especially interested in that field in this vicinity. He learned early how to use community resources.

"Thus the program for identification and help for such students in the general high school can be one requiring little administrative palaver and upheaval. It will boost the morale of the students in the department, and the teachers' faith that they are doing a valuable job But the program of identification and help seem closely intertwined. Testing is not our sole criterion of excellence of talent, nor the only feature of identification. Our identification program is based on the response shown to the help and opportunities offered."

Jean Strauchler of the Colfax School, Pittsburgh, Pennsylvania, has this to say about a WORKSHOP program in the elementary school.

"This article finds its setting at Colfax School in Pittsburgh. It is a six-grade school with an enrollment of 1200 students. The Workshop rooms are made up of children who have an I.Q. of 135 or higher on the Binet Test. There are three workshop rooms grades 1-6, the Junior, Intermediate, and the Senior. The purpose of these rooms is to group the gifted together to give them an enriched school program. This article is about the Junior Workshop Science Program which includes grades 1-2-3.

INTRODUCTION

"The gifted child has always found the subject of science an exciting experience. It opens roads of enchantment for him. By nature, the gifted child is inquisitive and is always seeking information. He has a great desire to find the 'why's' and 'Wherefor's,' and this is the one subject that has many hidden treasures. He loves to read about the wonders of nature and to experiment with his imaginative mind. In doing these experiments he is able to use all types of materials which give him an opportunity to express himself in many ways. To watch a gifted child work an experiment is a very satisfying experience.

"Grouping children together as it is done at Colfax School has helped them with their science program. When you walk into the Junior Workshop room, you will see science in every corner. There is 'Cotton-tail' the white bunny, roaming around and sniffing everything with which he comes in contact. Look further and you will see 'Sleepy' the Hamster, 'Squeaky' the white guinea pig, and 'Lightning' the white mouse. The cheerful song of 'Chirpy,' our white canary, draws our attention to him. These various pets have helped to create interest in the further study of animal life.

SETTING THE SCENE

"Bulletin board displays, pictures on various subjects, specimens and various materials to conduct simple experiments of nature, microscopes, a magnifying glass, test tubes, all become important properties to set the scene to stimulate the interest of children in science. The question often asked is, 'Where can one get all this material? Some school boards won't furnish extra equipment on science.' Most of the materials used in the Junior Workshop are received free of charge. Science materials are found all around us. In the daily newspaper—there are columns and corners devoted to science and one can find a wealth of material for children to use. Children bring in magazines that frequently contain valuable articles. There are teacher magazines that have information that can be used for bulletin board displays.

"Many materials can be found in inexpensive books. Children can bring in all types of things found around the home and the community, such as birds' nests, leaves, insects, stones, shells, etc. Children should be trained to be alert to the fact that wherever they go they can find something to contribute to the 'Science Display.' Material hunting can become an exciting game for the chil-

dren and at the same time it teaches them to be aware of the interesting things around them. This way of procedure is much more effective than those situations in which we hand the children all the material, regardless of how expensive the equipment may be. They lose all the fun of looking and discovering new and exciting specimens.

TECHNIQUES

"Now that the materials for the science displays have been gathered, the next thing to do is to find the best techniques to interest the gifted child in the further study of all the specimens that were brought in.

"Gifted children enjoy working in groups. This gives them an opportunity to do critical thinking, as they challenge each other. It also provides them with opportunities to share ideas, to work for others as well as with others, to learn to give and take, and to accept criticism in a gracious manner.

"Science club offers an interesting experience that children enjoy. Committees are appointed to investigate and experiment on any phase of science they wish. These meet whenever they find it necessary. There is a chairman and a secretary with each group. New leaders are chosen by the group after each experiment. On Friday the entire class assembles to hear the committee's report and watch a demonstration of the experiment made during the week. At this time these children find it necessary to so present their ideas and findings that those who are listening can understand. It gives the others an opportunity to practice listening to learn.

"In Pittsburgh, station KDKA, in conjunction with the Board of Education, provides a weekly science program on the air. The children have a delightful time listening to Joan and Ergo, the two characters in the Radio Program. In imagination they travel everywhere and learn much from this radio series. After each program there is a discussion led by one of the children and an assignment is given the group. The suggestion for the assignment is made by the class. Some of the subjects discussed in this series are:

Power for Tomorrow
Winter Birds
How Coal is Found
The Porcupine

Such subjects give the mentally superior child an opportunity to develop techniques of research and at the same time he has fun learning. The teacher is also certain that the subjects assigned are on his level of interests.

EXCURSIONS

"The Junior Workshop Science Program would not be complete without excursions. This is a very valuable part of the program. It gives the pupils an opportunity for real experience with nature. A visit to the park to study the trees, birds and all types of insects is for many children a new experience. Specimens are brought back, examined under the microscope, and information about the specimen found in the science books.

"A visit to the planetarium opens new vistas to the child. The stars, the moon, and the sun have a peculiar fascination for gifted children. As they sit in the auditorium lost in another world with Jupiter, Saturn, and Mars so close and real to them, an interest in the study of the Universe starts for some of these youngsters and with it further study and research to be carried on.

"A visit to the nature museum once a week creates excitement for the gifted. They can spend hours studying the pre-historic animals, the birds, the flowers, the under-sea animals, etc. For many children one visit isn't enough and they return again and again. There are always a few that continue to do more research on something that they discovered for the first time at the museum.

"Take the seven-year-old-boy that became very much interested in trees after our visit to the city park. He wrote about the 'Giant Sequoia' and the 'Vanilla Vine.' I'll quote part of his story—

'THE VANILLA VINE'

> 'The Vanilla Vine' is the tallest tree in the world. It is taller than the Eucalyptus tree. It has a short life of 50 years. The leaves are as large as two feet long and one foot wide. The shape is like a large Philodendron leaf. The flowers look like a yellow orchid. It has a yellow throat spotted with a reddish brown and brown spots.

After writing several stories about trees, he made a display of many types of trees and where they were found in the world. From his great interest in trees and because of his displays, others became interested and Jimmy and his friends formed a committee for the further study of trees and reported their findings to the class at our Science Meetings.

"A visit to a local department store where a glass-blower was displaying his art was a fascinating experience for the children also. They saw him melt the glass and then blow it up to form something beautiful. Some children were interested in how this art got started and did some research work.

"There are always so many exhibits that go on in a city. We had an opportunity to see the following exhibits:

Plastic and How It's Made
The Tulip Display from Holland
The Garden Exhibit
The Spring and Fall Flower Show
Pottery Exhibit
Chef's Exhibit

After the children have visited the exhibits with the group they usually make a return visit with their parents. We always discuss our experience after an excursion. The children have so many questions that they want answered that we never seem to have time to answer them all. Some research work has to be done in order to answer these questions and often the work is done by committees.

"An interesting experience the children had was the day they visited a neighboring community to see carrier pigeons being raised. The meeting was held in the yard near the pigeon coop. They watched the pigeons being fed. They saw some pigeons sitting on eggs. When the class came back to school they brought with them three pigeons in a box. A lunch was served to everyone including the pigeons. After lunch the pigeons were taken outside and set free. A note was attached to each pigeon's leg. The pigeons found their way home safely and the experience the children had will never be forgotten.

"Science is an exciting field for the gifted. It gives them an opportunity to do research work and to share their findings with the class. It gives these children an opportunity to investigate and experiment. They can work in groups and exchange ideas. They can find the answers to questions that are disturbing. All these experiences develop the child in a way that gives him great satisfaction. He learns how to find the answer to his own questions instead of being made to do them. Creating the right atmosphere for the gifted in the world of science will make the child happy, secure, and contented."

A BILL OF GOODS?

By GEORGE GREISEN MALLINSON
Western Michigan College of Education
Kalamazoo, Michigan
And JACQUELINE V. BUCK
Grosse Pointe Public Schools
Grosse Pointe, Michigan

No doubt all of us at one time or another read advertisements of the "newest thing" in television sets. We are assured that the new set can "reach out" and snare programs from stations far beyond the range of the "old models." Programs are free from distortion, interference and "flopover." The picture is locked in and everything else is locked out. So we purchase the set and then spend our evenings cursing our gullibility.

How similar this situation frequently is to professional meetings for elementary teachers in the area of science education! A "consultant" faces the group and explains, "What I do in elementary science." Usually the explanation deals with some technique for teaching science that works to perfection day after day. The students are motivated to the ultimate, many laboratory experiences are enjoyed, and the knowledge gained by the students is tremendous. However, many teachers leave such meetings with the impression that they have listened to the master teacher whom they cannot hope to emulate, or else that they have been sold a bill of goods.

While elementary science, like television sets, is a rather new "appliance" on the education market, its value and importance have been well established. However, like any new "product," it is at first likely to be misused or passed over. Elementary teachers often avoid the area of science in their teaching for a number of reasons, among them the following:

1. Many elementary teachers have had little or no training in science in their professional backgrounds.
2. Many teachers feel that they must have special apparatus and equipment in order to be able to teach science.
3. Many professional meetings and periodicals suggest to teachers that there is a "correct" way to teach science. Feeling uncertain as to just what the method entails, they avoid science as much as possible.

The efforts that may be taken to correct the problems just stated are to some extent related to one another. One obvious solution, of course, is to provide elementary teachers with more adequate training in science in their college work. However, this would be of no benefit to the present teachers; and, even for future teachers, it is not easily accomplished because of present requirements for college graduation and state certification. It does seem, nevertheless, that two steps may be taken:

1. "Consultants" at elementary-science meetings should take a more realistic and less platitudinous approach when discussing elementary science, and should provide teachers with some *functional* suggestions to assist them with their teaching.
2. In-service programs may be developed by school systems and/or teachers colleges for helping elementary teachers approach science in a more practical way.

Here, the discussion will be confined to the second point above, namely, suggesting basic steps that may be a part of a program of in-service education for helping teachers do a satisfactory job in teaching elementary science.

One of the essential steps in improving science teaching is that of planning. Such planning includes two aspects: (1) Pre-planning to meet the long-range objectives of elementary science, and (2) planning with the children for the implementation of these long-range objectives.

Pre-planning: If it is agreed that science shall be taught at the elementary level, and if it is further agreed that certain skills, attitudes and understandings are gained from a study of science better than from a study of other subject-matter areas, it then becomes clear that the teacher must devote some time to identifying these objectives, and must plan for their inclusion in her teaching. For the most part, the teacher must do this planning without the help of the students. Currently we hear much about "teacher-pupil planning," but in this respect, it is ridiculous to assume that an elementary-school child is capable of determining all, or even a significant number of the understandings, skills and attitudes of science that will be of value to him in later life before he even knows what they are.

It will be the task of the teacher, therefore, to establish the broad objectives of science which experience has shown to be of importance in the training of children. This selection will be made on the basis of a consideration of the total science program at *all* educational levels. This means that the objectives of science will be selected on the basis of the criterion, "What are the major understandings, skills and attitudes of science that *all* children should possess when they leave school?" After these objectives have been selected, the elementary teacher then should consider what she, in the light of the developmental levels of her students, can do to contribute to these objectives.

It is important to realize that these goals are *not* attained merely by selecting a large number of "essential facts" to be memorized. Rather, the objectives will best be reached through experiences that are related to the *training* that the students should receive. Thus, instead of placing emphasis on studying birds in the first grade, flowers in the second, and electricity in the third, the teacher's major aim should be to teach the children to think critically, to follow logical steps in problem-solving, and to apply what is learned. Each area of science that is studied should have potentialities for developing these characteristics in children.

Planning with the Students: Cooperative planning with the children in an elementary classroom may be used advantageously in determining the specific ways in which understandings, skills, and attitudes are to be learned. A skilled teacher may work with her class in selecting some of the specific science topics to be considered, and may determine through cooperative planning how certain problems may be studied. One caution here, however, is to realize that every student will not be equally enthusiastic about planning; nor will children's interests be equal in kind or degree. It will be necessary, in most cases, for the teacher to stimulate and sustain interest, since it is well known that children's interests are transient. In addition, negative learning may result from an attempt to exploit an interest intensively or over a long period of time.

A real interest is one that is related to a permanent and important part of the child's environment, and it is this type of interest that the teacher must attempt to stimulate. Interest is not merely a "happy attitude," but rather an appreciation of the importance of the topic under consideration. Hence, the most valuable use of *expressed* interests of children perhaps is to utilize them as starting points for the development of more mature interests and understandings.

Using these expressed interests, the children may be given several choices of science experiences. Naturally, the levels of maturity of the children will have an influence on the choices presented to them. With very young children, the teacher must often select the experiences, or at least control the experiences from which the choice is to be made, since the children may not be aware of limitations of time, money and materials involved.

Thus, if an elementary teacher realizes that science experiences can develop in children many valuable skills, understandings and attitudes, she has made a good beginning in the problem of teaching science. Then if she will carry out some careful pre-planning and cooperative planning with the children she may develop a satisfactory science program.

The 1954 annual meeting of the Central Association of Science and Mathematics Teachers will be held November 27-28, at the Sherman Hotel, Chicago, Illinois. Following traditional custom there will be general sessions with nationally known scientists and educators as speakers, and group sessions devoted to elementary science, general science, biology, chemistry, physics and mathematics. All teachers of science and mathematics are invited to attend. It is not necessary to be a member of CASMT.

Classroom Ideas

General

Unit Review With Slides

By THOMAS L. BAGSHAW, East Junior High School
Watertown, Massachusetts

An important but often neglected phase of the unit in the teaching of science is the review. By tolerating a review and summarizing the concepts and generalizations, a degree of attainment in direction of the teacher's objectives can be subjectively evaluated.

The utilization of glass slides and projector can be successfully employed for a stimulating review and as another guise of making science fun.

Illustrations and applications of the unit concepts and generalizations to be learned can be located in many of the science texts. This could be an assignment or an activity. "Locate an illustration relating to a generalization of this unit from a book on the reference shelf." The pupil should select an illustration that he understands well and is able to explain.

Tracing, labeling, and coloring should consume a maximum of twenty minutes of the period. The projection of the slides may be scheduled for a full period. Also plan on twenty minutes to clean slides after projecting.

Drawings may be traced or drawn on the frosted side with pencil (not too dark or heavy), ink, or crayons. Clear glass cut from thin window glass may be used with ink, India ink, or colored inks if desired. Allow ink to dry thoroughly before coloring is attempted; use small amounts of ink. By dipping the plain glass slide in a thin solution of gelatin a coated surface for writing with pencil or ink is provided. Plain glass may be etched by the class with a commercial paste, Etchall, or may be ground by using a spoonful of "glassive" and water and rubbed or ground on the slide. The ground glass slide is superior. It takes ink, pencil, or colors and has a softened effect of the drawing when projected. A three-dimensional effect can be attained by the careful shading off of colors from deep to light or by stippling the shaded areas.

Cellophane sheets, colored or plain, cut to size may be used for certain purposes with plain glass slides. By placing cellophane and carbon paper in a typewriter, copy can be typed in the usual way, or drawings and tracings can be made on cellophane.

Care should be exercised when using home-cut plain glass slides as the edges may be quite sharp. Binding tape or Scotch tape may be used to remedy this situation. At least a quarter-inch margin is suggested in order to have the complete image on the screen. Many of the illustrations selected will be either too small or too large to conform to the 3¼" x 4" slide. The following is suggested: to enlarge the illustration, trace outside of the perimeter lines and sketch in accordingly. To decrease the size, trace inside the border lines. A printed title or the concept of the illustration is desired, also labels on the diagram to a small degree. Pupils should be cautioned about too much detail in tracing. Upon completion, collection of slides will insure safe keeping before projecting.

Selecting a committee of three or four students to manage this endeavor can enhance the success of the review. The purpose of the committee is to pass out, collect, and file the glass slides; operate the projector; supervise the cleaning of slides. The projection of the slides should consume a full period if efficiently handled.

The slides are selected at random and as each illustration is projected the individual describes and explains the content demonstrated on the screen. He may ask questions or encourage criticism and added information following the presentation.

It is understood that the illustration may be original. The review encourages creative workmanship and the quality is greatly appreciated as evidenced by the comments of the class. The experience of speaking before a group and expounding on some knowledge that he has prepared will stimulate confidence in this individual. The attempt to develop scientific attitudes is aided by the class being conscious and observant of an illustration or an application that they can demonstrate in the assignment.

The advantages of using glass slides as a review: advances the premise, "Science is fun"; a timesaver; develops public speaking techniques; stimulates creativeness; improves attitude building; improves a unified conception of the unit.

Elementary Science

Convection Currents

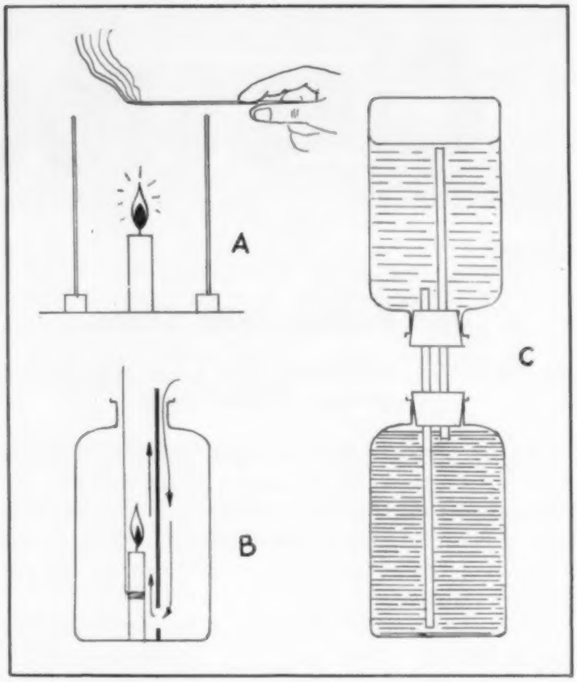
By FLORENCE CRUSAN, Teacher, Brookline School
Pittsburgh, Pennsylvania

(Presented at the "Here's How I Do It" session (elementary), NSTA National Convention, March 21, 1953, Pittsburgh, Pennsylvania.)

This subject of convection currents is often encountered in elementary school science; in the study of Heat or Weather, for example. There may be convection currents in liquids or gases. They arise from temperature differences (unequal heating) within the gas or liquid. The resulting currents circulating within the medium may be shown by the following simple experiments.

1. Place a chimney or tin can with top and bottom removed over a burning candle. Support the bottom of the cover on inch-thick (or so) blocks of wood so that it is not resting flat on the table. Trace the rising current of air by using a fringe of tissue paper attached to a length of stout wire or a small-diameter stick of wood or glass.

2. Use the same fringe of tissue streamers and locate the indraft and the outflow of air at a window opened partly at both bottom and top. This works best in a warm room when it is much colder outside.



3. To show that warm air does not rise of its own accord, but rather is pushed up by heavier, colder air, lower a burning candle (attached to a wire) to the bottom of a large-diameter, tall glass jar. It will soon stop burning. Now insert a cardboard divider in the jar, the divider having holes or notches cut at its lower end. Again lower the lighted candle into the jar on one side of the divider. Trace the convection currents with the tissue fringe.

4. To show convention currents in liquids, join two bottles with two two-hole corks or rubber stoppers in which two lengths of glass tubing have been inserted as shown in the drawing. The water in the lower bottle should be colored with ink or food coloring. (You may have a problem in assembling the bottles and keeping the water where you want it, but we'll leave that for *you* to figure out.) Support the bottles so they will not tip over and arrange to heat the water in the lower bottle. Setting it in a deep pan of *hot* water is one method; others can be devised. Avoid *strong* heating of the lower bottle, especially if you *do not* have an air space in the upper bottle. Note the convection currents as evidenced by the mixing of the colored warm water with the cold.

An extension of the meanings of these demonstrations may be related to an understanding of world winds and ocean currents. It may lead to the study of problems in heating and ventilation. Aviation-minded pupils may want to report on the way gliders operate.

NSTA Activities

Boston Regional Conference

Inasmuch as a copy of the full, printed program for the Boston meeting December 27-30 is being sent to all NSTA members (courtesy of W. M. Welch Scientific Co.), the details, list of speakers, etc., will not be duplicated in this issue of *TST*. However, it seems appropriate to emphasize again that a professional treat is in store for all who may find it convenient to attend. Elementary science and all the usual fields of secondary school science—general science, biology, earth science, chemistry, and physics—will be covered by program items. "Reports From Inside NSTA" and "Here's How I Do It" presentations are repeats of features which have been extremely well received in other NSTA conferences. And, of course, other program offerings will be offered by the AAAS and its other affiliated science teaching groups: ANSS, NABT, and the Cooperative Committee. Headquarters and most of the sessions will be at the Hotel Bradford. NSTA's representative and contact man in the planning is Dr. John G. Read, Boston University.

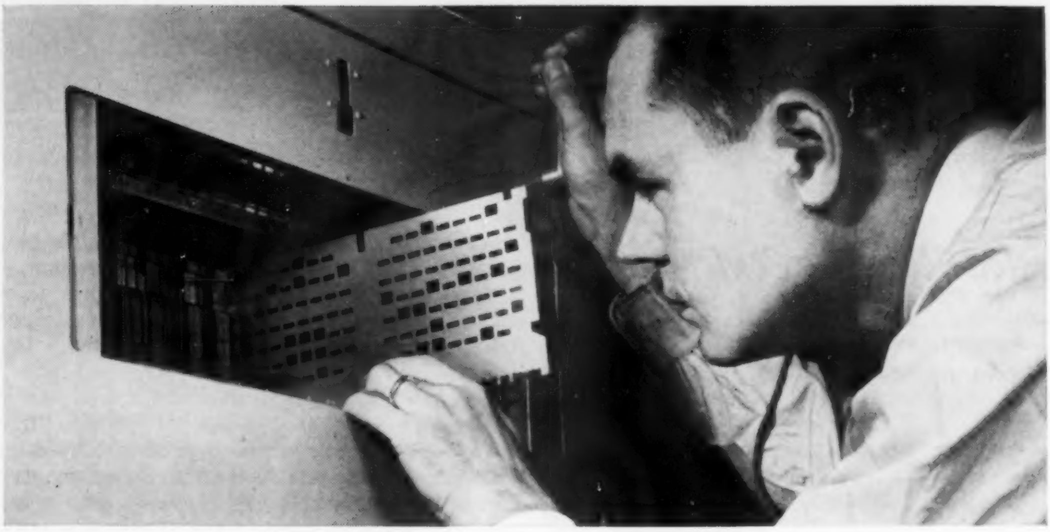
Speaking of Chicago

The 1954 national convention committee is now beginning to smooth out such details as booth assignments for exhibitors, room assignments for the various sessions, preparing registration cards and lapel badges, etc. All of which implies that program planning is practically complete. Invitations have gone out to chairmen and participants in the various symposia, clinics, and panel groups. The NSTA office is receiving a satisfying response to the invitation to members to volunteer to serve as consultants to the discussion groups. In addition to this kind of participation, the committee is also anxious to hear at the earliest possible time from those who may wish to volunteer "Here's How I Do It" presentations. Teaching aids and ideas of almost any variety that have been developed by teachers are welcome, just so they can be demonstrated and/or explained in about 15-20 minutes. Examples of recent presentations that were particularly appropriate are " 'Tis or 'Taint Soluble," "Electromagnetism" (for fifth-graders), "Teaching Genetics Through the Use of Hybrid Corn," "A Laboratory Test of Problem Solving Ability in Physics," and "A Simple Fuse Demonstration." Most of the items published in the Classroom Ideas section of *TST* would be suitable for presentation in "Here's How I Do It" sessions. The Chicago convention next April 1-3 will provide opportunity for perhaps 15 to 20 such demonstrations or talks. Those who wish to volunteer should write soon to the NSTA Executive Secretary and give their names and other personal data and a brief description of their proposed presentation. If a letter from an NSTA officer will be helpful in gaining released time to attend and participate in the convention, let us know and we will gladly cooperate.

Suggestions Invited By Committee on Nominations

As usual, the first step in the choosing of new NSTA officers and Board members is to invite all of the members to send their suggestions to the chairman of the nominating committee. Names, positions, institutional connections, and a brief account of the professional interests and activities of those whom you wish to suggest for consideration by the committee should be sent, by December 15, to Mr. Richard H. Lape, Amherst Central High School, Snyder, New York. Be careful to specify the positions for which your suggested nominees are being recommended. Officers and Board members whose terms expire this year were indicated on page 188 of the September, 1953, issue of *TST*. In making recommendations, remember that NSTA's concerns, activities, and membership service programs include the elementary, junior and senior high school, and college levels. The makeup of our Board of Directors should reflect this vertical distribution. We are particularly desirous of receiving names of suggested nominees from NSTA's affiliated groups, which now number 60 local, state, regional, and national organizations of science teachers. It is hoped to conclude this year's election in time to announce the new president-elect at the Chicago convention next April.

SORRY—but the omission of two names of committee members from the listing in the October issue of *TST* was purely a typographical error. Please add to *Committee for Boston Regional Conference,* Clifford R. Nelson, Weeks Junior High School, Newton, Massachusetts (see p. 189 of September issue of *TST*); also, to *Committee on Affiliated Groups,* H. Craig Saip, State Teachers College, Florence, Alabama.



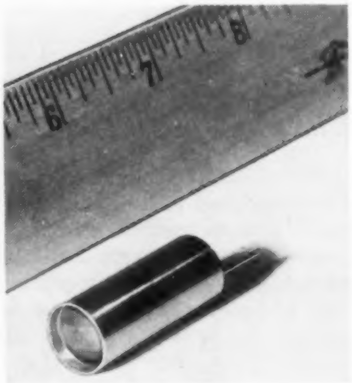
Checking perforated metal card in Bell's new "card file." If the first voice-way is in use, a "detour" is swiftly found.

CARDS FOR CONVERSATION

To find out how to route Long Distance calls a dial system needs lots of information – fast. To provide it Bell Laboratories engineers developed a new kind of card file–one that dial systems can read.

Punched holes on metal cards tell how calls should be handled. When a call arrives the appropriate instruction card is displaced so that its pattern of holes is projected by light beams on a bank of Phototransistors, which signal switches to set up the best connection.

The "card file" will have its widest use in speeding Long Distance calls that are now dialed by a telephone operator and may one day be dialed by you personally. It is another example of how Bell Telephone Laboratories helps telephony to grow, as costs are kept down.



New Phototransistor unit. Light entering cylinder is focused by lens on germanium that responds by generating current. Like the Transistor, the Phototransistor was invented in Bell Telephone Laboratories.

BELL TELEPHONE LABORATORIES

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

FSA Activities

Student Chart Making Contest:

We predict that the people who attend the Chicago National Convention of the NSTA next spring will be in for a pleasant surprise. They will have a chance to judge the final entrants in the Welch Student Chart Making Contest. From what we have seen of student posters during Homecoming Queen elections and other student activities, we look forward to seeing some really outstanding examples of creative design. The details of this contest may be obtained from the FSAF.

Science Achievement Awards: 1953-54

The 1954 program is really rolling along. As is the case with nearly every activity, however, there are things to worry about. For one thing, we wish there was some way to encourage more of the boys and girls who begin projects to follow them to a logical degree or stage of completion. Past records show that for every student who finishes a project, there are several others who leave projects at some point short of completion.

Sometimes those of us who are associated with student project work worry about the amount of originality and creativeness reflected in the reports of projects. We know that creative curiosity is the heart and soul of the scientific enterprise but one cannot always tell for sure what kind of student activity is truly creative or original. Some people sincerely claim that a student can show creativeness in the way he copies the work of another or repeats a classical experiment. We wonder if it would not be wise to advise boys and girls to emphasize those elements of their projects that they feel were truly original and reflected their creative ability.

At times we worry about the degree to which a student project becomes truly an episode in science. We wish we could spell out confidently the characteristics of a genuinely representative scientific episode. This is a task few people could hope to accomplish with satisfaction for all and, what is especially important to the boys and girls in the Science Achievement Awards Contest, to the satisfaction of the judges in the various regions. In general, we suggest that each project report can well include an explanation of the student's interest in the problem, the efforts taken by the student to become familiar with the information bearing on the problem, how hypotheses were elaborated and, finally, how these hypotheses were tested.

Science Teacher Recognition Awards: 1953-54

In addition to all of the other announcements of this program, over 25,000 copies of a flier were distributed inviting teachers to publicize their best teaching ideas of 1953 rather than "hiding their candles under bushels." If teachers will share their good ideas, not only will they stand a chance to win a prize but they will contribute to the professional growth of other teachers. Thanks to grants in aid from several of America's outstanding scientific societies, *Selected Science Teaching Ideas of 1952* is going through its second printing with 7,500 copies being ordered.

Looking to 1954:

Much thought is being devoted to determining next year's total program for the Future Scientists of America Foundation. Many ideas are being boiled down, redissolved, cooked some more, and generally worked over to see if they hold promise of increasing the science interests of boys and girls. Many of these ideas involve programs which impinge on classroom instruction. We feel that our American way of life and the way our younger generations have carried the ball for us in times of national emergency bear witness to the fact that teachers and their schools have been doing quite well by our total society. The program being planned for 1954 is intended to extend a helping hand to a profession that deserves constructive criticism and assistance from every organization, public or private, that can provide help.

Let us know if you have ideas about how the Foundation can use its contacts with industry to improve conditions for science teachers, their teaching methods, and the subject matter being taught.

Future Scientists of America Foundation, NSTA,
1201 16th St. NW, Washington 6, D. C.

Book Reviews

ROCKET AWAY. Frances Frost. 48 pp. $2.00. Whittlesey House. New York. 1953

What youngster could resist a rocket trip to the moon? *Rocket Away* provides children with the vicarious experience of just such a trip. This account of a trip to the moon by way of the Hayden Planetarium is vividly related on a level comprehensible to the average 8- to 11-year-olds.

The word usage is excellent; the vocabulary commensurate with a child's range of reading ability; and the illustrations provocative enough to fire the imagination of the very slow learner.

The science information is accurate and designed to answer many questions children might ask concerning astronomical phenomena with special emphasis on the earth's satellite.

The book cannot help but create an interest in rocket travel. When the book is finished, the reader is sure to request a Hayden Planetarium Application for a space tour in the future.

ALBERT PILTZ
University of Florida
Gainesville, Florida

FORCES AFFECTING AMERICAN EDUCATION. Wm. VanTil, et al. 205 pp. $3.50. Association for Supervision and Curriculum Development, National Education Association of the United States. Washington, D. C. 1953.

This short book is just what the doctor ordered for all people interested in understanding the broad problems facing public education today. Few teachers have an overview of the forces, trends, and movements in the national scene which are directly affecting the present and future welfare of teachers and children.

The major criticism of the book is that it is the product of several people closely associated in their daily work and who share common biases. If close association is a weakness, it is also a strength in that the authors were able to carefully coordinate their work with a minimum of overlap.

A refreshing viewpoint is presented in support of "Great Debates" in education. The stand is taken that educational policies must be derived from public thought and opinion, and that great debates have always benefited public education by engendering widespread thought and action among the citizenry in general. As an antidote for the unilateral activities of small pressure groups, teachers are called upon to be responsible for "bringing issues into the open for examination" and "helping young minds use the method of intelligence in examining issues."

The Yearbook identifies four major forces in education: culture, [pressure] groups, communication, and research. To each of these forces is devoted a full section of the book. An excellent, yet concise, argument is made for the position that American culture is a "permanently" evolving experiment in democracy. Some might argue about the diction, but few would deny the fact. The author examines nine cultural forces which tend to oppose the extension of free public education.

Another service to the reader is the listing and discussion of the major organizations which are now active in the current Great Debate about public education. After discussion of the motives, leaders and activities of these groups, the author philosophizes "Education thrives on honest, forthright criticism, advice and cooperation. . . . The threat comes from those who would indoctrinate. . . ." This section was limited to formally organized groups and did not include, for example, philosophers and their followers who have been such potent forces affecting education.

Probably the most analytical section of the Yearbook was that on communication. An interesting review of the development of the American tradition in the free expression of ideas was presented. Some blame was placed on public education for the steady decline in quality of press communication. Four "approaches" to communication were outlined, with the "know-nothing" as the weakest and the "public welfare" approach as the most appropriate in American society. Various policies governing communication agencies were also interestingly presented.

The section on research as a force affecting education was probably the weakest. Only a few

outstanding studies were mentioned and few of those mentioned were of a basic research type. No mention was made of the 50 year lag between research findings and the general use of the results in public education practices. No mention was made of the daily force affecting educational practice as a result of widespread individual experimentation among teachers who are becoming more research-minded.

The last section must have been intended as a summary since it stated, in somewhat different terms, many of the same points made earlier. It did, however, make a strong argument for improving school-community relations at all levels.

Not the least of the contributions made by this publication is found in the appendices. Appendix A lists direct quotations from the *New York Times Index* from 1949 to 1952. Each item summarizes a *Times* article describing some force currently affecting public education. Appendix B contains three important articles on public education written by Benjamin Fine, Education Editor of the *New York Times.*

GEORGE W. ANGELL
State Teachers College
New Paltz, New York

NUTRITION EDUCATION IN ELEMENTARY AND SECONDARY SCHOOLS. Department of Nutrition, Harvard University, School of Public Health. 43 pp. $1.00. The Nutrition Foundation, Inc., New York. 1952.

This booklet includes reports of several research studies in nutrition education established in Newton, Massachusetts, Rutherford County, Tennessee, and Ascension Parish, Louisiana, under the guidance and auspices of the staff of the Department of Nutrition, Harvard School of Public Health with the cooperating public health and educational agencies of the three localities. The report offers many helpful suggestions for getting a nutrition education project under way in an attempt to improve the food habits of school age children. References, available materials to assist such a program, and a detailed chart on the cooperating resources at the local, state and federal levels offer specific suggestions for furthering such a program.

Diet and nutrition information are a part of most elementary and secondary science programs. This report will aid such science programs in becoming more practical and personal in their approach to bettering food habits.

BETTY LOCKWOOD WHEELER
Central Michigan College of Education

BAKER—continued from page 276

Even during the last fifty years we have seen nation after nation revert to the primitive methods of getting what they wanted, through war with all its violence, rape and murder. We should inspire our students to plan a society in which science is given a free hand for continued development and the applications of science are directed to providing comforts and conveniences for all; a society where freedom of communication among men is assured and the exchange of ideas and ideals is promoted.

It has been said that man has made more progress during the first fifty years of the present century than in the five thousand years that preceded it. It is safe to predict that a comparable progress will be made during the next fifty years now that the atomic age has begun. Since the young people of today are the guardians of the future, they should be inspired to accept the challenge to aid in this progress.

(2) By showing the scale of values resident in science and the scientific method. There are some who say the scientist does not deal with values—does not choose values but merely discovers facts. I do not agree, since from the initiation of an experiment until its completion he must make choices. He must choose between truth and falsity; honesty and dishonesty; good and poor technics, humility and bigotry; freedom and coercion; understanding and fear; patience and impatience; accuracy and inaccuracy. Constant making of such judgments tends to shape the character of the individual. Needless to say that impressionable youth can be definitely molded toward the highest type of personality if he practices making the choices demanded in science.

Science unshackles the minds of men, from superstition, prejudice, fear and traditional authority and replaces with understanding, tolerance, courage and truth. The world today is in dire need of this mental cleansing.

Perhaps the most helpful choice the scientist makes so far as modern youth is concerned is between adventure and security. The trend in political systems during the last quarter century has been to promise security and remove the hazards which citizens face. Regardless of the -ism which holds out such promises their programs have a great appeal to most men. Man as a whole prefers security to risk and adventure. He dislikes change. Experience shows, however, that security is a will-o'-the-wisp except when all freedom is sacrificed. I am told that Alcatraz is the last word in providing security for its inmates, but strange to say few can be found who really desire to go there.

Science does not offer an easy way or a short cut to understanding. It seems to me, however, that our generation needs to be inspired to welcome honest effort and hard work as a means of getting results. They must be inspired to accept failure along with success, thorns with their roses; indeed, in the words of Browning, "To welcome each rebuff that turns earth's smoothness rough; that bids us sit nor stand, but go." Any organism, human or brute, gains strength in struggle—in meeting dangers and overcoming them. To slit the pupal case to help the pupa emerge produces a butterfly with weak and almost useless wings.

(3) By presenting to the student the many unsolved problems in each of the fields of science, chemistry, biology, physics, geology, astronomy, psychology, agriculture and medicine. Instead of our having reached, as it is sometimes stated, the golden age of science, I believe we have scarcely scratched the surface of its unplowed ground. We have scaled only the foothills of the frontiers that circumscribe our movements. The great mountain peaks are yet unexplored. Let us challenge the youth of today with these unpenetrated frontiers.

As we "conspire" tonight in order to "inspire" through science, we should remember that youth accepts challenges to risk and adventure and puts forth his best efforts to meet them if he has clearly stated goals or objectives. I should like to propose three goals for consideration toward which we may turn our best thoughts along with others in enlightened nations everywhere and toward the attainment of which we may well seek to inspire our students.

(1) To learn to live together as free men on this planet with other free men in peace and happiness, with the basic needs and comforts provided for all, and with the exercise of intelligent good-will, motivated by mutual trust and understanding; (2) To learn to join with all men everywhere in war against the non-human enemies common to all men regardless of race, creed or color—enemies such as disease, poverty, ignorance, tyranny and greed—instead of dissipating our wealth and resources, both material and human, in war against each other; (3) To learn to make the most effective use of the great reserves of human time and energy made available through the harnessing of constantly improved machines.

These goals are not new. They have been in the dreams of many men throughout the ages. I think they may be restated today, however, since we have in the methods and technics of modern science better means of attaining them than has any previous generation. I do not mean to imply that science alone can bring these objectives to fruition. It is

unfortunately true that man has gained greater understanding and control over his material environment than he has over himself. He can come to a better understanding of himself, however, if he uses the disciplines of the experimental sciences in the solution of his social, economic and political problems.

> "The spirit of science is needed in a troubled world. We need a rededication to the ideals of truth and justice. We need to remember that science dedicates itself to the discovery, organization, and humanism of truth. We need intellectual integrity, not mere mental cleverness. We need wisdom, knowledge, with the capacity to use it; we need clearer perception of objectives and the best means of attaining them; we need perspective in human affairs. We need to apply the rigid standards of scientific truth to the solution of human problems."
>
> E. C. Stakman, *Retiring President,* A.A.A.S., Dec. 1951
> *Science,* Feb. 9, 1952

What a golden opportunity the science teacher has for training, challenging and inspiring the youth of today in preparation for tomorrow! I count it a privilege to have conspired with you tonight in order that we may more genuinely inspire those whom we teach.

DECKER—continued from page 279

1. Some things can be changed into other things.

   Grade 3—Bring a pan suitable for making fudge and have some kind of stove or hot plate available. Use the following recipe:

   Chocolate Fudge

   $\frac{2}{3}$ c. cocoa
   3 c. sugar
   $\frac{1}{8}$ teaspoon salt
   $1\frac{1}{2}$ c. milk
   $4\frac{1}{2}$ tablespoons butter
   1 teaspoon vanilla

   Combine sugar, cocoa, and salt. Add milk and bring to a boil, stirring frequently. Cook until a small amount of the mixture forms a firm ball when dropped in cold water. Remove from heat and drop in the butter. Cool to lukewarm, add vanilla, and beat until the mixture thickens. Pour into a buttered dish and cut in squares.

   1. What did we use?
   2. What happened to the things we used?
   3. What did we make?
   4. How is the fudge different from the things we put into it?

B. Energy exists in many forms and causes changes in matter.

1. We can make things move.

   Grade 2—Put some books in a cardboard carton, and draw two chalk lines 10′ apart. Have children individually push the carton from one line to the other. Put enough books in the carton so that the child will have to expend some energy to push it and will tire in a short time.

   1. What have you done?
   2. Why could you do it?
   3. What did you use to push the books?
   4. Why are you tired?

2. Energy causes many changes.

   Grade 5—A small toy balloon is tightly fastened to a glass bottle. Place the apparatus in bright sunlight for a few minutes. The balloon will move and probably inflate a bit and stand erect.

   1. What has happened?
   2. What made it happen?

Questions to Direct the Thinking of Children During the Activities

The teachers made questions for each activity to direct the thinking of the children so that they could develop the important concepts inherent in the activities. Only the major questions were recorded. Many other questions might also be asked during the activities. The teacher should be sure to ask the main leading questions important for the development of the concept. The teacher's

questions are as important as the activity. Making fudge, for example, may be a pleasant pastime or a good science activity; the teacher's questions make the difference. Examples of the questions are printed below each activity.

Summary

When the teachers had finished their work, they had examples of concepts, activities, and questions for each grade level and for each of the major generalizations. The plan for the elementary science program in each school was flexible and could be adapted to each grade level and each community. The examples of the concepts, activities, and questions could be used or others could be selected as the teacher wished. This plan also made possible an evaluation of the present program in each of the schools. By listing the concepts and activities of each teacher under the appropriate generalization, a group of teachers could discover if certain areas of science are being neglected in the school science program. Plans to include these neglected areas can be made. Teachers can also discover those activities that have been a part of the program and should be kept. There is no need to discard what is good and to "begin all over again."

Science as a subject is itself in a constant state of change. Elementary science programs must be constructed so that the new and important changes in the field of science have a place in them. Current science is not important because it is current science, but because it helps to add additional meaning and significance to great generalizations and themes that are important for an educated person to understand.

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DERRICK—continued from page 283

soon replaced by tungsten. It is used in spinnerets, electronic tubes, as a catalyst, for plates in bone injuries, and to suture nerves. Its carbide is very hard and useful for fountain pen points. Most of its uses depend on its high melting point (which is exceeded only by that of tungsten), hardness, malleability, resistance to corrosion, and its very great heat conductance. It is in competition with platinum. It is found in South Dakota, Brazil, Belgian Congo, British East Africa, Netherlands, Australia, and South Rhodesia. Only a few tons are produced in the United States. An attempt is being made to obtain it as a byproduct from the extraction of titanium from brookite (2).

Titanium (1791)

Titanium, the fourth most abundant commercial metal, constitutes 0.58% of the face of the earth. Over sixty mineral species contain titanium, the most important being ilmonite (31% titanium) and rutile (60% titanium). A research project is now under way to determine the feasibility of extracting titanium from brookite, titanium dioxide. Brookite occurs in the United States, whereas the chief source of rutile, another titanium dioxide, is Australia. The United States is currently using 25,000 tons of rutile, annually, of which only 7500 tons are domestically produced (2). Its extraction is difficult. Known reserves are inadequate (5). Producers in this country are Arkansas, Florida, New York, and Virginia.

Titanium dioxide is an important paint pigment and is used to give opaqueness to several textile fibres. Titanium is slightly more dense than aluminum and is twice as strong as iron and harder than stainless steel. It is more corrosive resistant than steel and holds its strength at high temperatures. Alloyed with chromium it forms a metal suitable for high temperature uses in jet propulsion and in atomic energy plants. The medical profession is interested in its use since preliminary tests have shown that it has excellent corrosion properties and causes no harmful reactions with body tissue (22). It is produced by chlorination of the dioxide and treatment with magnesium.

The associated press reported recently that the Japanese government will subsidize a titanium smelter with the hope of producing 1000 tons next year. It has been reported that a plant for production of titanium will be constructed soon, to be financed by United States government loan costing $25 million. It will have an annual capacity of 6000 tons, which is several times present national production. The plant will use some rutile, but the chief ore will be ilmenite slag from Canada (12). At the request of the British government, Australia is undertaking special research in titanium (17). Its price is from $5.00 to $15.00 per pound, depending upon whether it is in the form of forgings, sheets, tubing, or ribbon (17).

Zirconium (1824)

Zirconium occurs more abundantly than nickel, copper, lead, and zinc. Domestic production is limited to Florida, where beach sands are used. Other states containing commercial amounts are California, Oregon, and Idaho. Foreign sources are Australia, India, and Brazil. Debs Smith recently reported in the United Press that four or five years ago zirconium was so rare that all of it "could be contained in a small box." Present day methods are producing "several thousand tons a month" and the cost is "only a tenth of the previous figure." Research on atomic power plants seems to have centered interest on this rare metal, because of its failure to absorb neutrons (23). "For water-cooled reactors of the type the submarine will use, zirconium is superior to iron, steel and aluminum for its other properties, too—lightness, strength, high melting point, resistance to corrosion and ease of working." (23). In 1950 it was priced at $250.00 per pound. It is now valued at about $13.50 per pound. Tons of it are now being produced, and it can be made 99.5% pure. It resembles tin in metallic properties. "Zirconium metal has been produced by arc dissociation of zirconium tetraiodide. Yields of 97.7% were attained" (11).

Conclusions

This great consumption of metals started in England and spread Eastward through Central Europe and Westward to the United States. In this belt extending through Russia is located more than 90% of the world's iron and steel capacity and the heart of the world's major industrial development. It has been referred to as the "power belt" of the North Atlantic. The Southern hemisphere has less than 2% of the world's iron and steel and almost as low a percentage of industries using other metals (10). In other words modern civilization has developed to the greatest extent in those areas rich in iron. The United States with 7% of the world's population produces about 40% of the world's goods (21). This is being done by one half of the American working population earning its living in 1952 producing things unknown prior to the airplane and automobile. Such data as that presented

in detail above clearly show that we are world dependent for these many metals to carry on the program of maintaining our own high standard of living as well as the program of lifting other nations above their present low standards. So where are we headed, with a constant drain on irreplaceable scarce metals coming largely from the so-called backward nations? How are we to build up such nations when they are being drained of frequently the only resources they have in order for us to maintain our standards and for them to live as they do?

Much thought has been given to such questions and much more will be required before satisfactory solutions to the problems are obtained. The following suggestions have been made:

1. The sea holds huge reserves of metals. Magnesium has been extracted commercially from sea water for several years.

2. Transmutation is a remote possibility, but it seems that such a source as an economic possibility is a long way off.

3. Some plan for international cooperation, conservation, and distribution should be worked out. The Atlantic Charter and the United Nations may be a step in the right direction.

4. Stockpiling has become a major practice. A difficulty here is that many of the scarce materials do not keep in storage indefinitely.

5. The United States and Great Britain must remain political friends because the two jointly control more nearly the metals and other raw materials needed for modern civilization than any other combination of nations. For the same reasons we must remain friendly to our neighbors both to the South and North.

6. New discoveries will be made and suitable substitutes for metals will be found. Glass, plastics and organic materials of various kinds are being used. Organic materials are replaceable but inorganic ones are not. It seems obvious that metals will always be used for certain special uses though. For example; brass or steel for cartridge cases, aluminum or copper for major conductors, specialized metals for jet engines, and other special purposes.

7. Increased knowledge will be put to use in extracting metals from ores that have been previously unusable, especially the silicates. For example, aluminum from clay and iron from taconite are recent advances in this area.

8. Reclaiming of metals is a possibility. This, however, introduces many problems, one of which is that it is much more difficult to get alloying elements out of metals than it is to introduce them.

9. As for elements above ninety-nine, Glenn T. Seaborg reports that "we know now that five will be of the rare earth type, continuing the actinide series. Numer lo4 will be like hafnium—tetravalent with a very simple chemistry" (4).

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